DEC 14 1943

The Welding Engineer

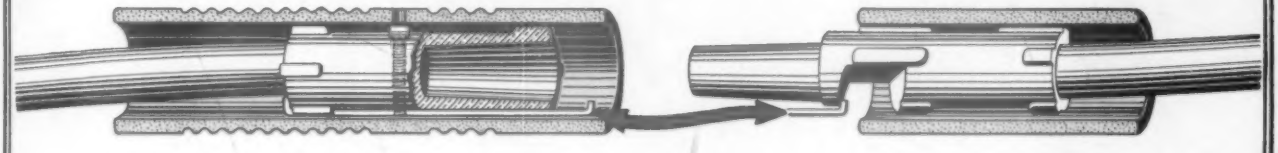
DECEMBER, 1943

THE PIONEER TECHNICAL PUBLICATION OF THE WELDING INDUSTRY

Jackson's QUIK-TRIK CABLE CONNECTOR

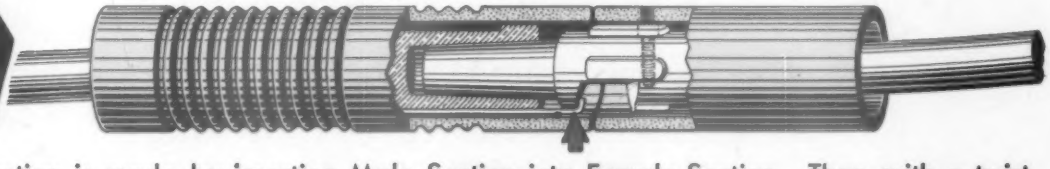
Locks TIGHT,
quickly unlocked

—fully insulated . . . SAFE



Female Section is soldered to cable lead Male Section is soldered to cable extension
Removable insulators are securely held in protective position with Allen screws.

HOW IT WORKS..



Connection is made by inserting Male Section into Female Section. Then, with a twist, the locking spring rides the cam into position holding both sections tight.
To unlock, simply twist apart.

PATENT APPLIED FOR

Important: Female Section, installed on cable lead, as shown above, may also be used as a handle and connected directly to the "Stinger" end of a Jackson Model TA holder as shown below. The adaptation saves time and material, eliminates the danger of live cable ends and makes possible the economies of standardization.

QUALITY JACKSON PRODUCTS

Contact your nearest Jackson dealer or write for Bulletins D and D-CC.

(above) Typical cable extension assembly for users of Jackson Model TA holders.

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Westinghouse Announces

A NEW HIGH-FREQUENCY STABILIZED A-C WELDER FOR LIGHT GAUGE WORK

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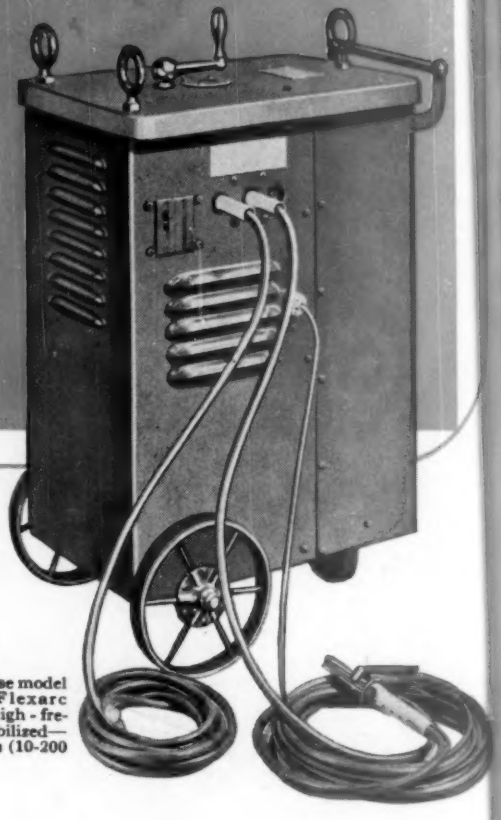
It meets the four major requirements for aircraft welding service:

1. Ability to strike and maintain an arc easily over the entire range of welding on light gauge work.
2. Easy stepless current adjustment.
3. Ability to weld all types of alloys as readily as carbon steel.
4. High efficiency and power factor.

The new Westinghouse Type WC-AC Welder eliminates the need for "adapting" welders intended for other types of service with their slower and less flexible performance. Superimposed high frequency makes the a-c arc practical on light materials at low currents and boosts welding output. Further, the price of the Type WC-AC welder is comparable with that of regular d-c welders.

For more information on the new Westinghouse High-Frequency Stabilized A-C Welder, call your nearest Westinghouse office, or write today to Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

J-70413



Westinghouse model WC-AC Flexarc Welder — high-frequency stabilized—175 amperes (10-200 amperes).

CHECK THESE FEATURES

1. High-frequency arc stabilization permits operator to strike the arc quickly and hold it steady at current settings as low as 10 amperes.
2. Movable core provides very fine stepless current adjustment.
3. *Double range* current adjustment for welding of special alloys—results in extremely fine current adjustment from 10 to 70 amperes.
4. Preset current indicator permits adjusting for desired welding current *before* starting.
5. Switch-in-handle electrode holder (included in accessories) provides pilot control of the high-frequency stabilizer.

Westinghouse

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A-C WELDERS

The Welding Engineer

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IN THIS ISSUE

ARTICLES

Shipfitting Training School 43
F. W. DUNN

Welding M-4 Tank Hulls 46
WILLIAM BOESE

Molding with Carbon Paste 48

Electronic Control of Gas-Cutting Machines 49
R. D. McCOMB

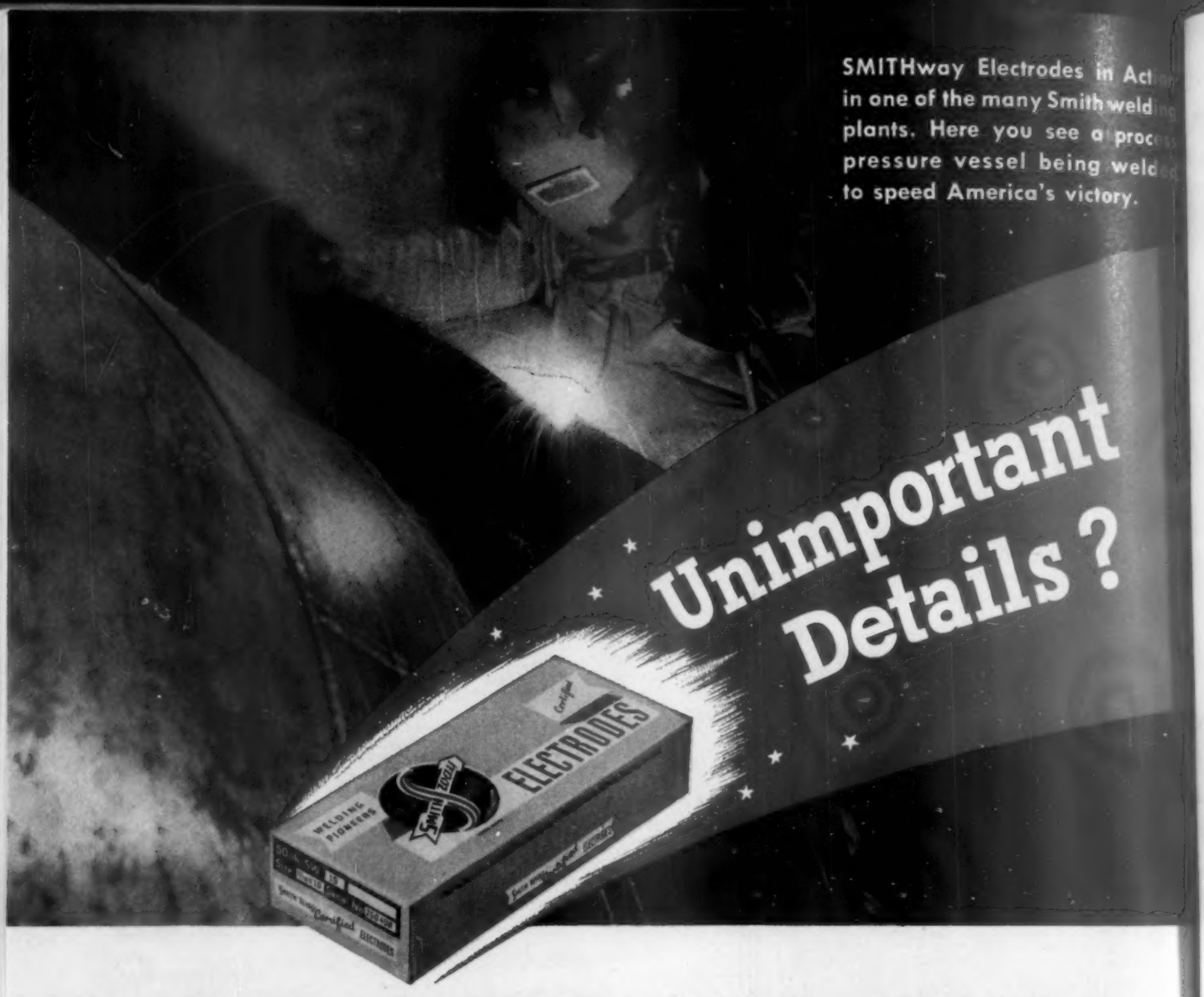
Welded Heat Exchanger Tubing 52

Welding Methods for Copper and Copper Alloys—II 56
J. J. VREELAND

Articulated Induction Coils 60
ROBERT CLEELAND

Australian Welded Trailer 66
ALFRED J. THOMSON

Editorial 41
First and Last 64
Welded Chains Boost Steel Output 68
On the Job 70
New Products to Use 74
Engineering Data Sheet No. 39 75
News of the Industry 80
About People 88
Helpful Literature Just Published 92
From the Patent Office 98
Classified 105
Advertisers in This Issue 106
Your 1943 Index of THE WELDING ENGINEER 107



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Why can't we slight even the smallest detail in the manufacture of SMITHway Certified Welding Electrodes? Here's why! It is an everyday occurrence for men in our plants to weld vessels that must withstand working pressures up to 5000 psi!

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made by welders . . . for welders

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

Save the White Collars

"Soak the Rich" has long been the cry of elements of the populace, and this job has been well done—on certain rich. But it wasn't enough. War expenditures added to years of excessive spending have now made it necessary to soak everybody—even those with incomes which can scarcely be called magnificent under any standards.

The income tax was originally intended to equalize taxation—to apply the load in accordance with capacity to pay. Nothing much wrong with that idea. The plan of high taxes for the rich, low taxes for the poor caused lots of good-natured grumbling, and income taxes vied with mother-in-laws as one of the country's stock jokes. But no one was actually hurt. The rich and middle classes could afford to pay their taxes, and the poor didn't have any. Then came the war. And taxes began to go up. And up. And up, *up*, UP!

The rich? Well, there weren't enough of them to make much difference politically so confiscatory taxes were levied on all higher salaries. The only rich to escape unscathed were the "parasitic royalists"—generally rich because of inheritance rather than by their own labors—whose wealth had been foresightedly put into tax exempt bonds. These gentry weren't bothered too much.

After the somewhat limited supply of rich-without-tax-exempts had been exhausted, the squeeze began to be placed on the White Collars. And what a squeeze! Remember the pit made famous by Poe which moved inwards from all sides to force the victim into the path of a razor-sharp pendulum? Something like that has been happening to all those unfortunate enough to have been associated with the White Collar. Their salaries were first "stabilized" under the guise of blocking inflation. Then their Federal taxes were raised to take something like 20% of the stabilized income. And the remaining four-fifths had to be stretched to meet higher prices on practically everything the White Collar man eats or uses or wears.

Most White Collars are good patriots. They have sons who are fighting the Nazis and Japs. They don't want to let those sons down. They put their savings into War Bonds—not tax exempt. They are even satisfied for their salaries to remain "stabilized," if that be necessary to the winning of the war. What they don't like, however, is to get it three ways—same old income, higher living costs and much, much higher taxes.

The White Collars, representing a major portion of the middle class, are the largest groups of voters in the country, but they are unorganized. Not being represented by a pressure group in Washington, they can take only what bones happen to be thrown their way. And those bones of recent months have had pitifully little meat upon them.

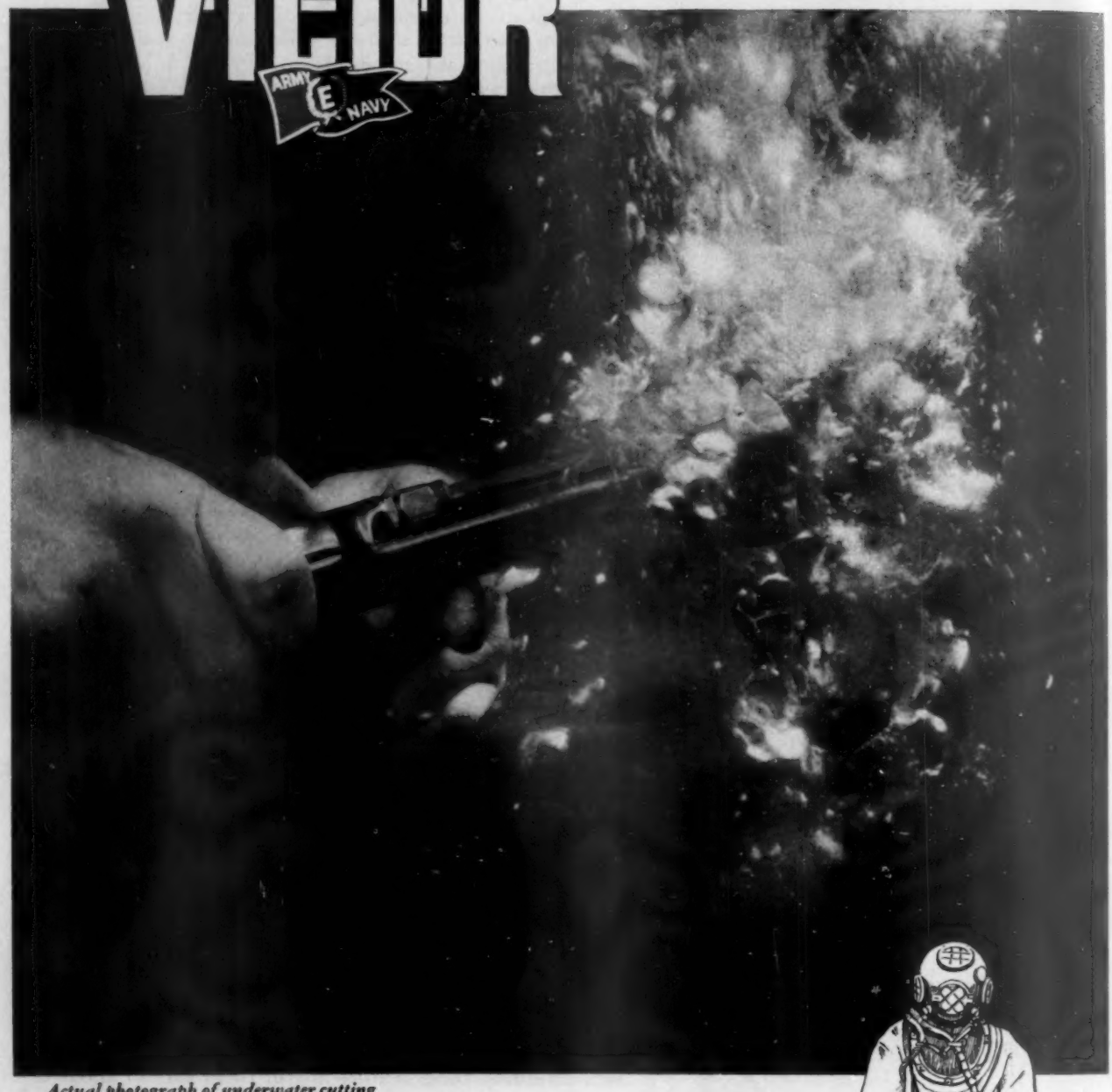
As individuals, there is little any of them can do about the situation, but as an organization, this group could control perhaps as much as thirty or forty million votes. Thinking, standing, voting together, the White Collars could become the most powerful stabilizing factor in our Government.

In the interests of self preservation, the White Collars must sooner or later join forces—and it should be done now before politically powerful faddists and selfish pressure groups succeed in pushing through measures which will wreck private enterprise beyond all hope of repair and leave us a nation of but two classes—bureaucrats and peasants.

Only a free nation supports a middle class. If the United States is to be kept free, the White Collars must be rescued from the economic slavery which now threatens them. Their dignity and freedom must be preserved from the tyranny of Government appointees.

VICTOR

ARMY E NAVY



Actual photograph of underwater cutting

Whether it be an underwater cutting torch which helped to salvage the damage of a treacherous attack at Pearl Harbor or a welding and cutting unit at an important Army air base or aboard ship, there is one primary qualification such equipment must possess—DEPENDABILITY.

Victor equipment is dependable in operation and the sturdiness of its construction greatly lessens repair and maintenance problems.

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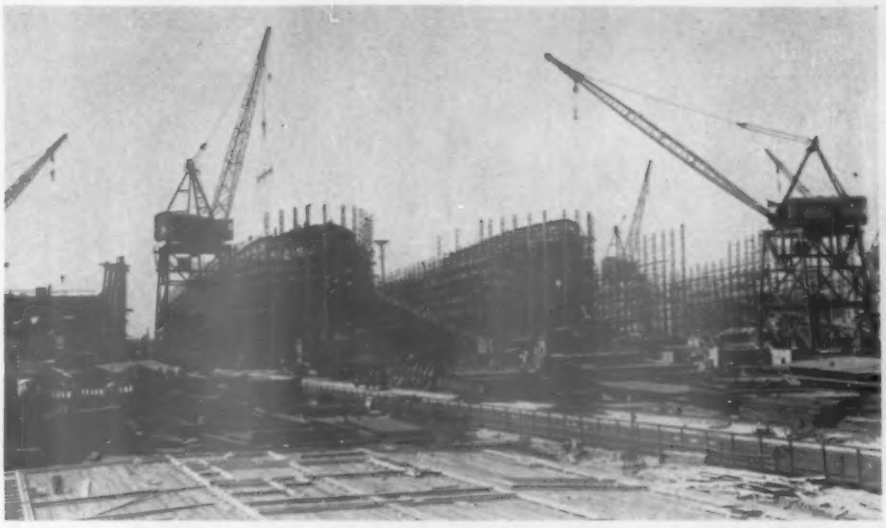


Looking across the platens at the Brunswick Yard of the J. A. Jones Construction Co. Six platens lead to six shipways, affording straight-line production from fabrication shop to finished hull.

Shipfitting Training School

By building a miniature Liberty ship to scale, students at the Brunswick (Ga.) Shipyard learn how to work upon the "real thing." The small ship job, it is stated, is eliminating many extra hours of work in the classroom.

By **F. W. DUNN**
Brunswick Shipyard,
J. A. Jones Construction Co.

Among the various trades represented at the J. A. Jones Construction Company's Brunswick Shipyard, Brunswick, Ga., none has been less "glorified" than shipfitting. That fact is somewhat puzzling because upon shipfitting rests the backbone of this industry. In fact, if one were to trace the story of shipbuilding back as far as 4000 B. C., he could not help but note how important to the production of the finished ship is the fitting of each piece of metal, wood and sail into its proper place.

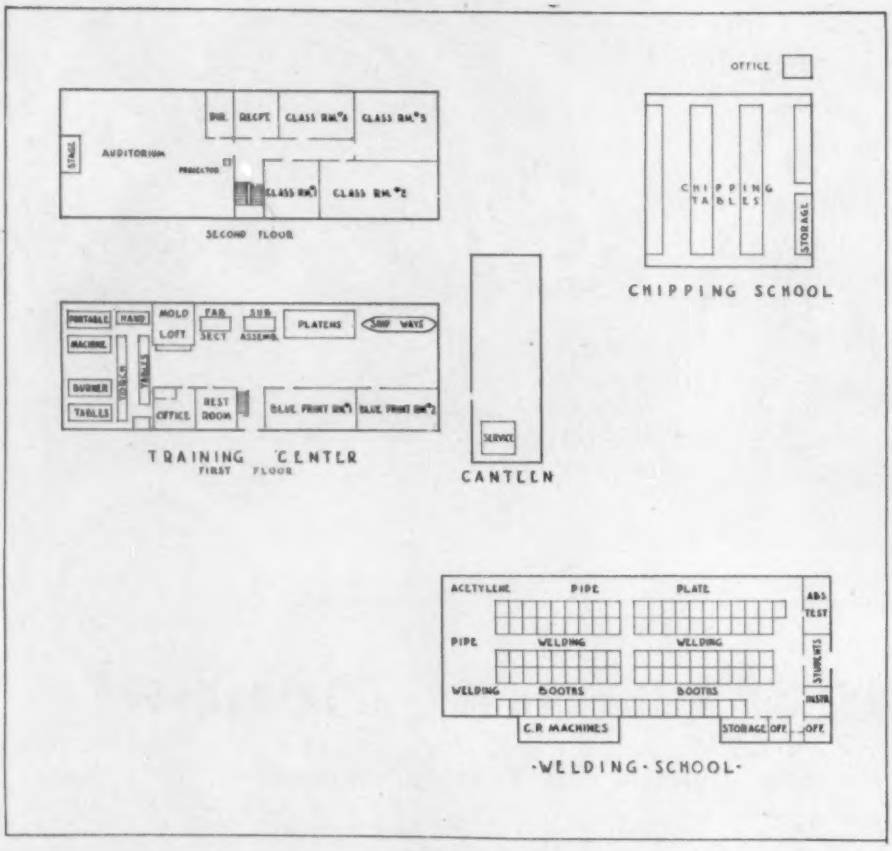
Shipbuilding History

To digress briefly, the original ships were of two crude types: the tree-trunk canoe hollowed through the use of abrasives, knives and fire and the round, tublike coracle fashioned from twigs and hides. It took the Egyptians until about 3800 B. C. to discover that if trees were sawed into flat planks and these were afterwards fitted together, a much more seaworthy carrier could be made.

Later on the Phoenicians developed shipfitting to such an art that they were conceded to be the greatest mariners of the ancient world. We'll skip over contributions made by the Greeks and the Romans and the brave seamen of the Middle Ages and pause at the eighteenth century when Britain's Phineas Pett and his son Peter were earning an enormous reputation as shipfitters by building the famous *Sovereign of the Seas*. It was this vessel which first gave to the shipbuilding world an inkling of the vast progress that was soon to come. So skillfull were these English shipfitters that their *Victory*, launched in 1765, was chosen by Lord Nelson to be his flagship at Trafalgar Bay.

Other craft which have made shipbuilding history are *Old Ironsides*, the keel of which was hewn from live oaks on St. Simons Island, Ga., and

A typical Liberty ship being readied for delivery. Approximately 446 feet long, the vessel can accommodate the material carried in 80 freight cars.



Plan of Training Division, Brunswick Shipyard. These facilities are ample to train 600 future shipfitters daily.

the *Monitor* with its turret which revolutionized sea-fighting. These ships and others—down to the modern floating fortresses and hotels of today—bespeak the speed, skill and accuracy which are requisite to shipfitting.

The Shipfitter's Duties

A glossary of shipbuilding terms defines a shipfitter as: "a mechanic who makes templates, marks, assemblies, and fastens in place, shapes and plates for the hull of a ship. He should be able to do any fitting on a ship."

Authorities differ on the degree of skill involved. In any case, the Brunswick Shipyard has found it necessary to train hundreds of shipfitters to work upon its six ways. For this training, one of the Southeast's most complete shipfitting schools is maintained under the direction of A. D. MacKay, training director, who is assisted by E. M. Powers, chief instructor, H. B. Sikes, assistant chief instructor on the first shift, and Roy Carter, same position on the second—plus twelve other instructors.

1,600 Graduates

As an indication of progress at Training Division, more than 1,600 shipfitting trainees were graduated within a year. Of these, approximately 150 are women. Many of the initial trainees are now leadermen and quartermen at the Brunswick yard, where approximately 3,500 shipfitters are employed in building Liberty ships.

A considerable portion of this shipyard is devoted to training operations. The shipfitting school is located in the Training Center building (see accompanying plan). On the main floor there is laid out a miniature mold loft, fabricating shop, platens and shipway for trainees to use in the construction of a miniature ship. There are also two classrooms. Two more classrooms and a large auditorium are located on the second floor.

Build Miniature Ship

Thought to be a unique feature of the Training Center is the miniature ship, constructed to ¾ in. scale, of a Liberty EC-2 type. The model is built of ⅛ in. and 3/16 in. steel, which is fabricated right in the training area. All plates are shaped by hand, fitted together by instructors and their trainees and "sealed" by welding students. With the exception of machinery, the miniature is complete in every detail. Great care has been exercised in the little vessel's production stages, under the theory that shipfitting students are enabled to visualize actual construction work and may thus learn how to avoid costly mistakes on the construction of full-size Liberty cargo carriers.

Such interest is manifested in the miniature ship's progress that the shipfitting and welding graduates who laid the keel return frequently to check the workmanship of their successors. Instructors contend — and rightfully so — that the small ship job has eliminated many extra hours in the classroom.

What the Course Covers

There can be no argument with the claim that the Brunswick shipfitting course is practical. Latest methods of teaching are employed, including motion pictures with sound and ex-

A miniature Liberty EC-2 ship is being built at Training Center for the purpose of acquainting trainees with every stage of shipbuilding. Here Shipfitting Instructor L. I. Purcell demonstrates to a class on the scale model.

aminations after actual hand manipulations on the miniature ship. Upon completion of the course, which can be accomplished in about two weeks, a trainee is assigned to a shipfitting department engaged in "the real thing"—the production of more vessels for the Victory Fleet. Brunswick shipyard school facilities are complete enough to train six hundred potential shipfitters daily.

To be more specific, the J. A. Jones Company's shipfitting course includes:

Orientation (safety rules, time cards, recreation facilities, etc.).

Locations, ship lines, surfaces and dimensions.

Glossary of construction terms and abbreviations.

Welding symbols.

Shipbuilding materials and shapes.

Shipfitting tools and their uses.

Basic blue prints.

Assembly and erection from prints.

Assembly and erection of the miniature ship.

Paid to Learn

Shipfitting training is not only entirely free, but students start at 68c per hour, advancing to 86c upon graduation.

Even the most hardened shipyard man may well thrill at the sight of hundreds of Georgia's helmeted shipfitters walking down to the Liberty ships under construction on the six ways. For as Major-General W. P. Upshur of the United States Marines said in a recent speech: "The shipyards' craftsmen, men and women alike, are as much defenders of our country as are the men in uniform. Without the ships and those who build them swiftly and skillfully, our military effort would be in vain."

Recreation plays an important role at the Brunswick Shipyard. The Choral Group, which frequently sings at launching ceremonies, is conducted by Christos Vrionides, former conductor of the New York Civic Symphony and a composer of note.

Layout men in a shipfitting class. They work to 3/4 in. scale in the construction of the model Liberty.

Bow assembly of miniature Liberty. Left to right are: A. D. MacKay, training director (who was formerly with the Frigidaire Div. of General Motors), and Elton Powers, chief instructor.

Shown inspecting a stern assembly are Julian Elkins (left) and Andrew Clough. Both of these shipfitting instructors like the way the yard's minature ship helps them to teach trainees.

Welding M-4 Tank Hulls *

Good practices for sound welding on armor are: clean material, proper root openings, proper heat for each size of rod, proper speed of travel and clean joints.

By **WILLIAM BOESE**
Superintendent of Welding,
Pullman-Standard Car Mfg. Co.

WHETHER in war or in peace, American industries can be depended upon to produce the best. One example is the M-4 tank, needed quickly—and in vast numbers—to stem the flood of Axis troops which threatened to overrun the entire world.

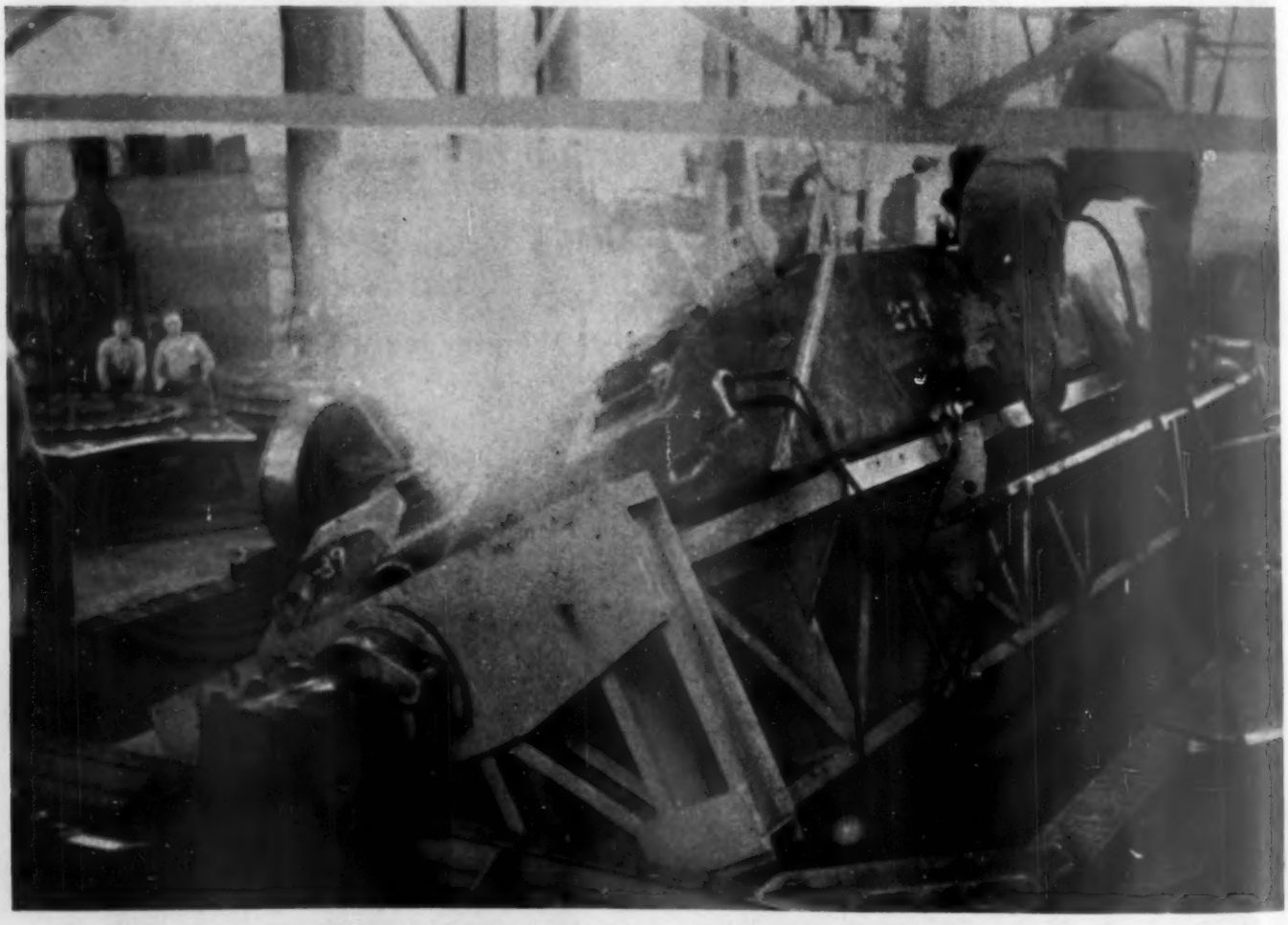
The all-welded hull of this tank is one of those developments which harken back to the research and study that was carried on during peacetime days. Here at Pullman-Standard we had been using welding for some time to build stronger and lighter railroad rolling stock. Because of the success we had with this program, we knew that welding could offer much to the manufacture of armament. More than two years ago we were working with the Army in conducting tests on the welding of armor plate, and our samples were successful in going through the fire tests at the Aberdeen proving grounds.

Making Pilot Hulls

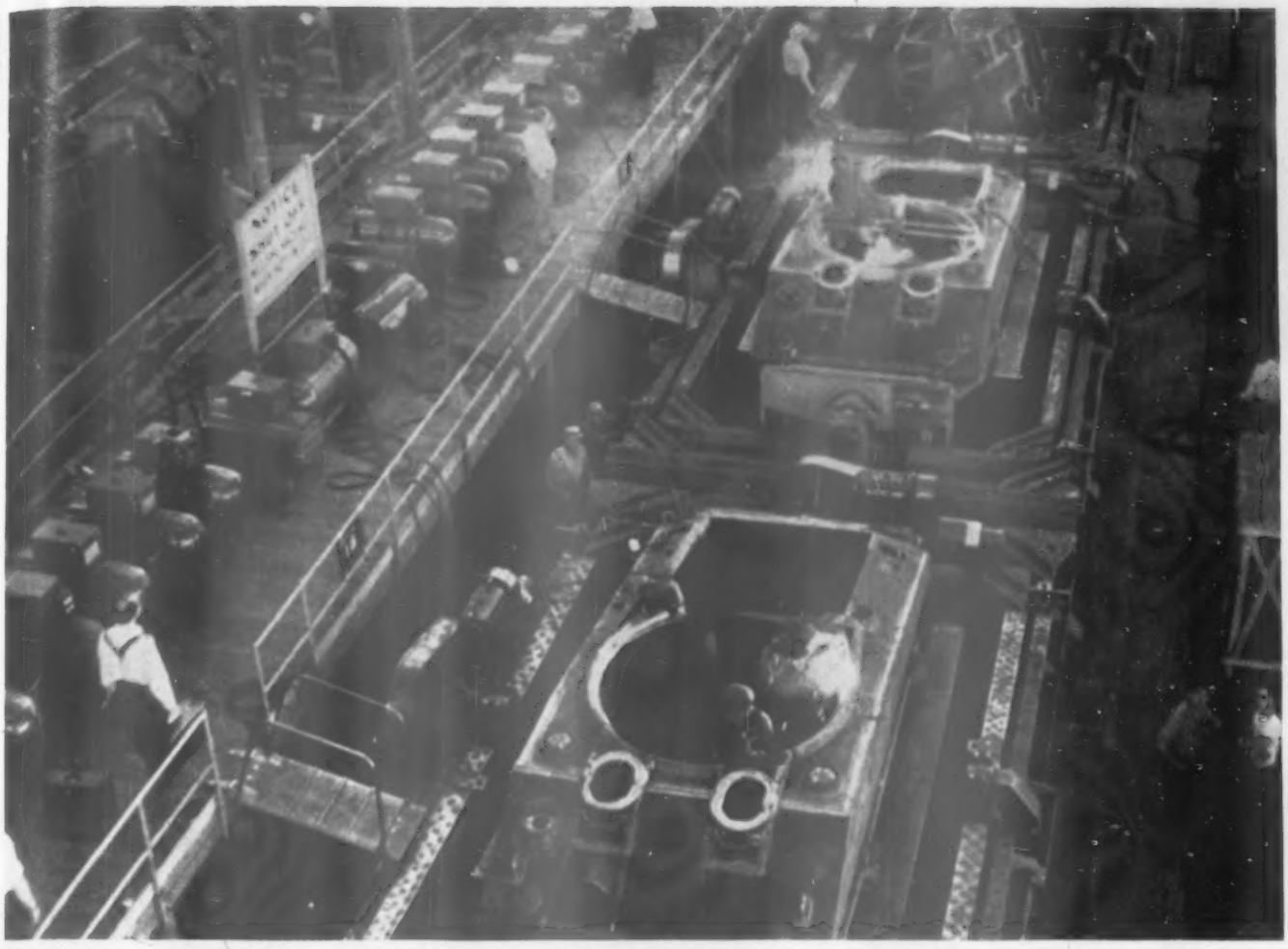
At the beginning of the M-4 tank program, two pilot hulls were made. Careful measurements were taken before and after welding in order to determine the allowances that had to be provided for to produce the hull of the proper dimensions.

One of our first problems involved the construction of fixtures which would permit the hull to be readily removed. With rigid fixtures, we could not pull the hull off after shrinkage had taken place and, furthermore, we did not like the idea of subjecting the hull to the additional stresses which would be set up

* *Abstracted from a paper presented at the annual meeting, AWS, Chicago, Oct. 18 to 21.*



Giant manipulating jigs tilt the hull into position for all downhand welding.



The manipulators are mounted on trucks so that they can be moved to carry the hulls along the assembly line.

in the welded joints, even though the fixtures were made with removable bolts or wedges to release the hull.

Back in the days when we were building the first streamlined train (which required a great deal of welding), we learned that by allowing a welded joint to "breathe" during welding much trouble would be saved. We knew this to be particularly true of armor plate.

Solved by Air Cylinders

Accordingly, we designed our fixtures so that one side would be rigid on a base while the other side moved in or out. This movement was made possible by the use of air cylinders. Air pressure forces the movable half of the fixture out to the expanded dimension of the hull and holds it firmly until the six long seams have been welded. Since the pressure is not sufficient to counteract the action of shrinkage, a free movement of the hull is permitted during cooling.

Removal of the hull from these stationary fixtures is very easy: the air is simply shut off, and the movable side then retracts two inches, leaving the hull free.

We have 24 positions to which the hulls are carried for welding operations. Weldors remain at the same positions along the line day after day. Some weldors have been working on the same joints for more than a year and have become very adept. Another advantage is that any indications of bad welding can be traced immediately. Schedules have been worked out so that the welding at each of the 24 positions is completed simultaneously and the entire welding line is moved at one time.

Giant Positioners

Our production of M-4 tanks is increased by the development of giant manipulating jigs, which tilt the hull and the stationary fixture as a unit into position for downhand welding. Thus we can use large electrodes and increase production. By mounting these manipulators on trucks they can be moved from one position to another without removing the hull.

The plates are fitted before the hull goes to the manipulators, and all material is either shot blasted or ground to insure good weldability. All material is checked for size and bevels before it is applied to the hull.

Root joints are held wide enough so that proper welding can be done from both sides. All hand welded joints have an included angle of 45 deg or more with a $\frac{3}{16}$ in. minimum root gap. Copper back-up bars are used while depositing root passes. After welding one side of a joint, it is cleaned by chipping or grinding and then inspected before the opposite side is welded. This is to make sure that we will have a clean joint.

Both A-C and D-C equipment are used.

Welding Techniques

Electrodes which deposit a concave bead are not used in root passes. Neither do we use an electrode which deposits a full crown weld with a slight necking down at the fusion line. Both of these will cause no end of grief. In my opinion, the bead formations which have a slight crown or one perfectly flat are far superior to the other two types. Parallel joints have been frowned upon from the beginning of the program and eliminated wherever possible. We use the overlapping or stringer bead method on all manual welding. Annealing beads are likewise used wherever possible.

Molding with Carbon Paste

Not all weldors know about this versatile welding tool which can be used to protect machined surfaces or to make molds for missing parts.

IN MANY welding jobs, a need frequently arises for a fire-resisting compound that can be readily molded to any desired shape. Carbon paste is wholly satisfactory for this purpose. Unlike clay, plaster of Paris and other molding material, it does not stick to the metal. Furthermore, it does not shrink or crack when heated.

Intelligent use of carbon paste by the operator can save a great deal of time and effort in preparation of the job prior to the actual welding operation—a saving most significant as preparation often consumes more time than the actual welding.

Typical Uses

There are a hundred and one different uses for carbon paste in connection with welding. If there is a threaded hole near the break to be welded, it can be filled up with carbon paste in order to prevent the oxy-acetylene flame or arc from burning or otherwise injuring the threads. When building up metal around threaded or irregular-shaped holes or when it is necessary to use a welding torch between machined surfaces, much time and machine work can be saved by using carbon paste as a protective covering. It can also be used to protect gear teeth and other finished surfaces that are immediately adjacent to the section being welded.

Molds for pieces that have been broken off a casting can be fashioned with carbon paste at the point on the main casting where the break occured, and weld metal flowed in to form the desired shape. Building up a broken gear tooth is a common application of this technique. Obviously, the machining and finishing work required is reduced to a minimum by this method. Molds for odd-shaped pieces can also be made of carbon paste.

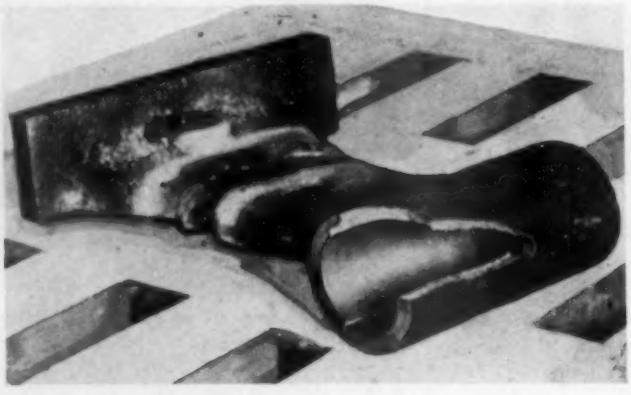


Fig. 1—Repair of castings with missing parts is a problem often encountered by the welding shop.

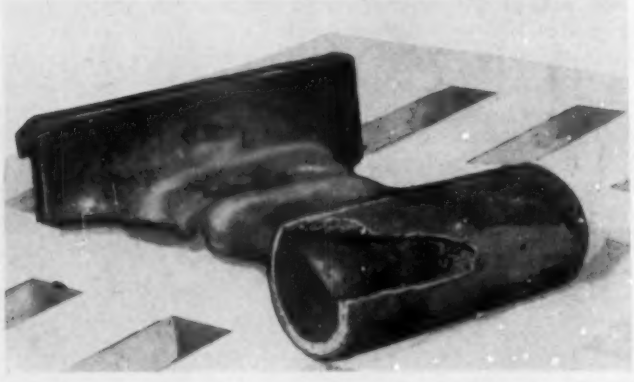


Fig. 2—A core is constructed of carbon paste. The paste should be firmly pressed into place and the surface smoothed with a putty knife.

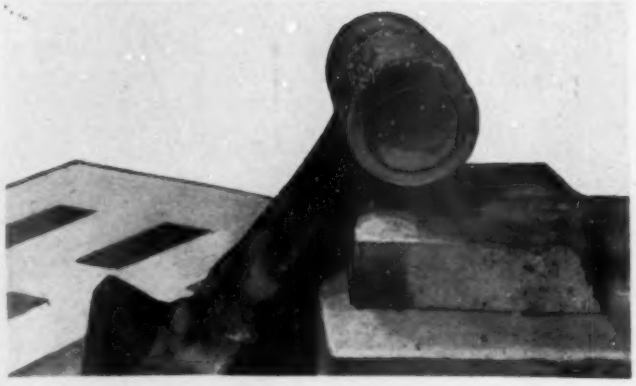


Fig. 3—The casting as it appeared after the new metal had been deposited. Machining and finishing work have been reduced to the minimum.

Where Parts Are Missing

Castings and other parts requiring repair will sometimes have pieces of sizable proportion entirely missing. The accompanying illustrations show how the combined problems of supplying the missing metal and keeping the part in proper alignment can be solved if the weldor keeps a supply of carbon paste on hand.

Fig. 1 shows a broken cast iron support for a drill press table. A roughly triangular piece about 2 in. wide and 4 in. long was missing. To make the job even more difficult, the break extended into a threaded hole for a set screw near the center of the casting.

The bore of the casting was filled with paste, which was pressed firmly in place and the surface smoothed with a putty knife as shown in Fig. 2. Provision for the new hole was made by forming a small quantity of paste into a core of the required shape (using what was left of the original hole as a guide for size and location). The casting was then rebuilt with metal from cast iron welding rods, thoroughly fused with the base metal.

Fig. 3 shows the casting after it had been welded and annealed. Note that the contour of the new section is so nearly perfect that very little finishing work was required. After the casting had cooled, the carbon paste was removed and saved for future use.

* * *

Photos, courtesy of The Linde Air Products Co.

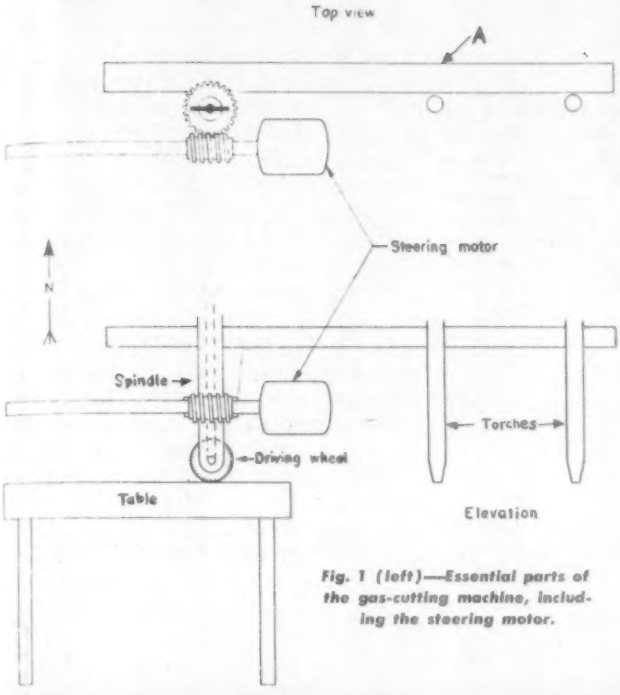


Fig. 1 (left)—Essential parts of the gas-cutting machine, including the steering motor.

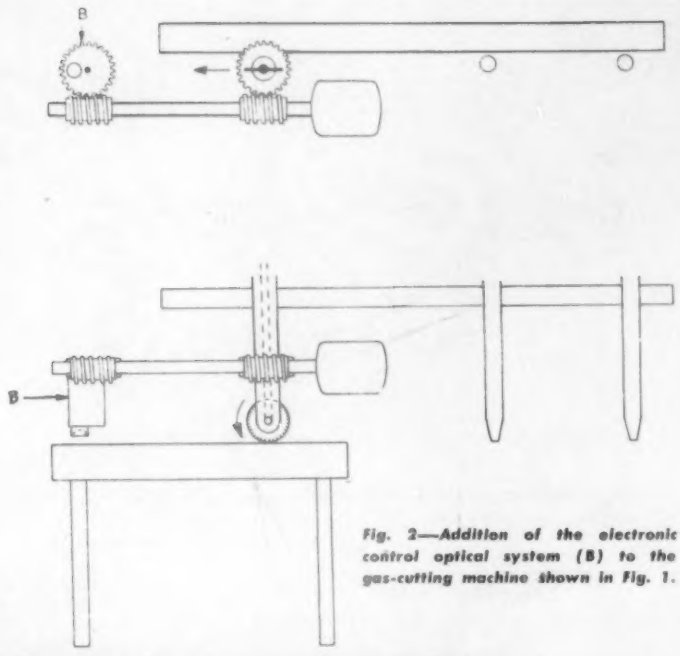


Fig. 2—Addition of the electronic control optical system (B) to the gas-cutting machine shown in Fig. 1.

Electronic Control of Gas-Cutting Machines*

By **R. D. McCOMB**

Electronics Section, Industrial Control Div., General Electric Co.

Considerable thought and study has been devoted to methods of guiding flame-cutting machines. This ingenious device tackles the problem from a new angle—the variations of light falling upon photo-electric tubes.

THE electronic control described in this article is designed to guide the gas-cutting machine around a template consisting of a pencil drawing on white paper and to guide it automatically, absolutely independently of the operator, once the cut has been started. The operator is relieved of the responsibility of guiding the tracing or driving wheel around the template and so may spend his time planning the next cutting job or adjusting the torches or cutting speed.

This control eliminates the factors of human error and operator fatigue and makes 100, 1,000 or as many pieces as are required, each part exactly like the preceding. This greatly facilitates inspection of the work as the inspector can simply measure one piece of each lot and be assured that all the remaining pieces are of the same dimensions.

Use Paper Template

Another advantage is the ease with which templates can be made and stored. The template simply consists of a piece of paper or white cardboard upon which is drawn the shape to be reproduced. The drawing may be done either in heavy pencil or in ink; pencil is generally preferred since corrections can be made more easily. In order to obtain a more permanent template, it is possible to use a narrow ink line backed up by a wider pencil line, or to use a striping device to make a wide ink line. Spraying templates with a thin coat of clear lacquer will help to prevent soiling due to handling and dusty atmospheres.

Blueprints (or black-and-white prints) may be used as templates if the errors due to paper shrinkage and

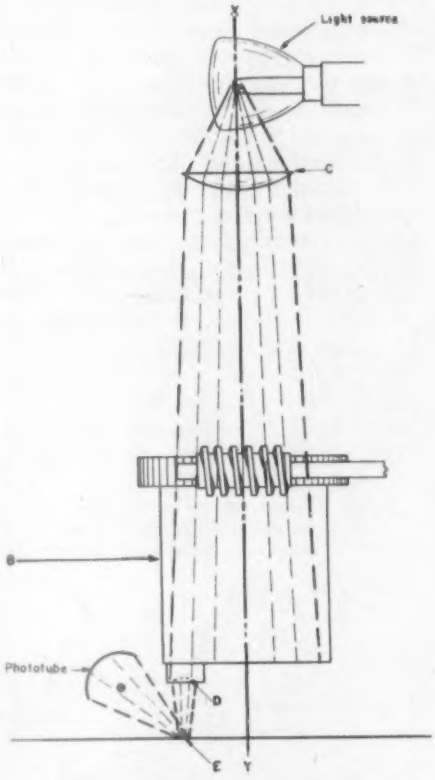


Fig. 3—Details of optical system. The amount of light reaching the phototube will depend solely upon the surface of the paper at point E.

* *Abstracted from a paper presented at the annual meeting, AWS, Chicago, Oct. 18 to 21.*

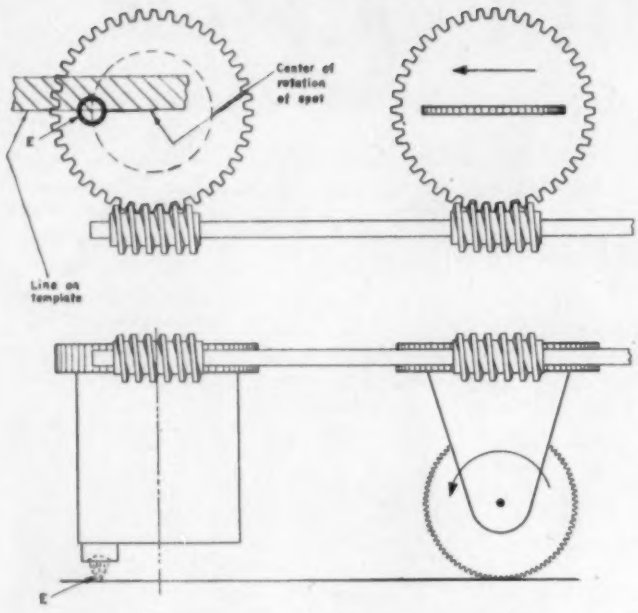


Fig. 4—Position of the light spot, E, when the control is following a straight line. Note that the spot is half on the line of the drawing and half on the adjacent white surface. In this position, steering motor is at rest.

slippage when passing through the blueprint machine are not objectionable.

Steering Motor

Fig. 1 shows a sketch of a portion of a gas-cutting machine. Member A may be the tracing arm of a pantograph-type of machine or the cross-carriage of the two-track type of machine. In operation, this member will always remain parallel to the east-west line (top view), although it may be driven in any direction by the driving wheel.

The driving wheel is rotated at a constant speed by a driving motor. The steering motor, shown in Fig. 1, rotates the spindle in order to guide the machine. The operator may steer the machine in any direction by rotating the spindle, and the motor simply performs the function formerly accomplished by the operator; namely, that of rotating the tracing-wheel spindle so that the tracing-wheel is guided in the proper direction. The gas-cutting torches are mounted on the same member and thus exactly follow the motion of the axis of the tracing mechanism spindle.

In Fig. 2, another gear has been added to the steering motor shaft, and a drum (B) is geared so that it rotates with a ratio of 1:1 with the driving spindle.

Phototube Unit

Fig. 3 shows a close-up of this drum, which is supported on bearings so that it may rotate about center line XY. The light source and lens C flood the entire bottom end of this cylinder with light. Lens D, mounted a short distance from the center of rotation, collects some of this light and projects it in the form of a small spot on the paper template at point E. One or more phototubes are mounted so as to receive the light reflected back from the template, and this reflected light causes to be produced an electrical signal which is proportional to the amount of light reaching the phototubes.

Since the amount of light which reaches the paper at point E is constant, the amount of light which reaches the phototube will depend solely upon the surface of the paper at point E. If this is plain white paper, considerable light will reach the phototube and its electrical signal will be fairly large in magnitude. If a black line, however, has been drawn on the paper at point E, it will absorb much of the light received from the optical system so that the amount of light reaching the phototube (and the electrical signal) will be small.

Straight Line Position

The position of the small spot of light, E, when the control is following along a straight line is shown in Fig. 4. The steering motor is at rest when the spot of light is half on the black line and half on the white surface of the template adjacent to the line. If the spot of light moves in either direction away from its correct position, a signal is given to the steering motor to return it to the proper position. If the spot should approach closer to the line, as shown in Fig. 5, both the optical system and the driving spindle will be rotated in the counter-clockwise direction. If the spot should tend to leave the line altogether and therefore strike the white paper surface, as shown in Fig. 6, the optical system and driving spindle will move in a clockwise direction.

Following a Curved Path

This response is not limited to merely one position of the spot; the control can continue to follow around a circle or other curved path as many times as may be required.

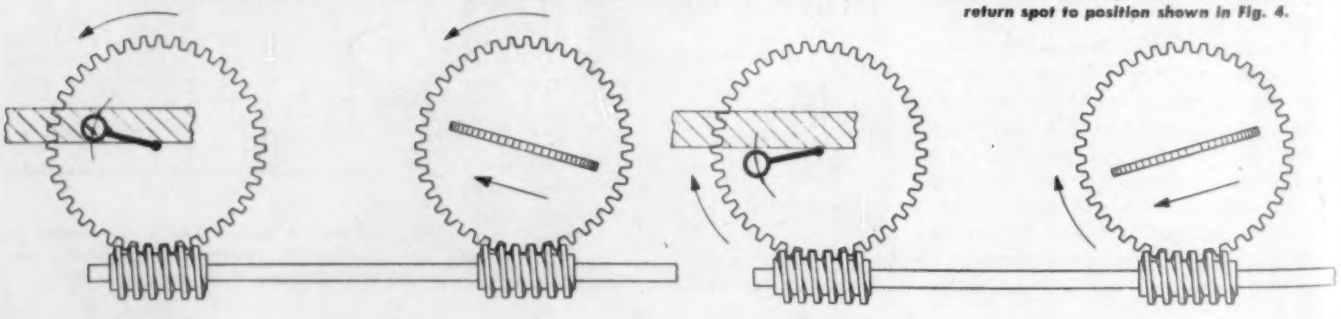
When following a curved line as shown in Fig. 7, the spot will always be traveling in the direction indicated by the driving wheel and would, therefore, tend to leave the edge of the line if the steering motor did not turn the driving spindle clockwise. Thus the spot will never be quite centered on the line but will follow in such a manner that slightly more of its area is on the white paper than on the black line. Hence a slight signal is continuously given to the steering motor with the result that the control is smoothly turned around the circle and produces a smooth, clean cut.

Square Corners

The action of the control when steering the machine around a square corner is shown in Fig. 8. The spot approaches the corner as shown in *a* and *b*. In *b*, it is just beginning to leave the straight portion of the vertical line, and the phototube is beginning to receive more light than it received at *a*. By the time the driving

Fig. 5—Spot too far on the black line; the control turns the driving wheel counter-clockwise.

Fig. 6—Spot too far on white surface; the control turns driving wheel clockwise to return spot to position shown in Fig. 4.



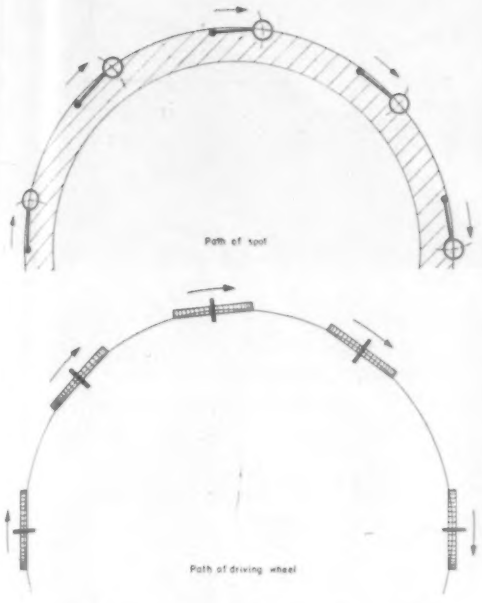


Fig. 7—Operation of the control in following along a curved template (greatly exaggerated).

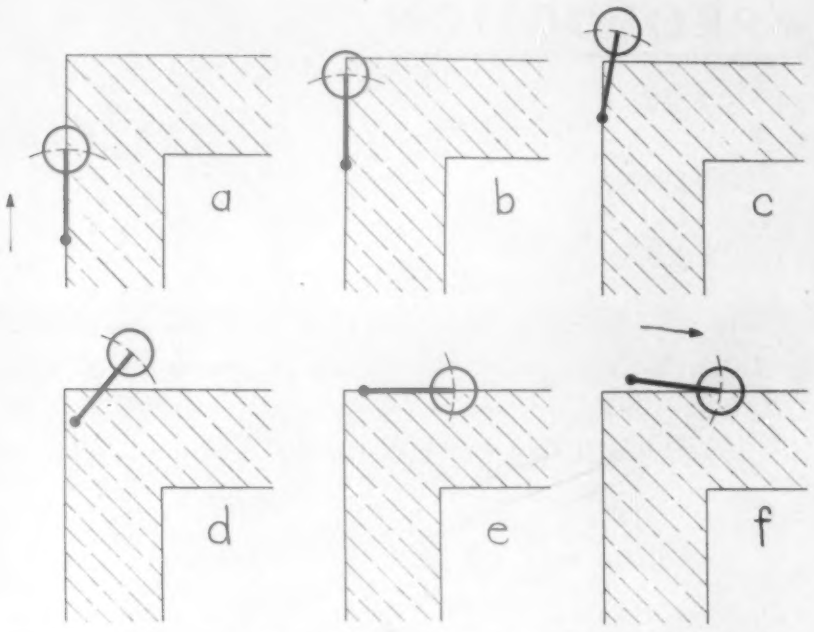


Fig. 8—Operation of the control in following a right-angle corner (greatly exaggerated).

wheel has advanced the carriage to the position *c*, the steering motor has begun to rotate the optical system and the driving head and will continue to do so while the spot advances through the position shown in *d*. As shown in *e*, the control will reposition itself, with the spot approximately half on and half off of the black line of the template. Due to the inertia of the machine carriage, however, the true position of the torches may pass slightly beyond the new line of motion as shown in *f*.

Cutting Accuracy

As has already been seen, the true position of the torch does not correspond with the true position of the spot when going around a sharp curve or corner. If the machine is traveling quite slowly, as would be the case when cutting heavy material, the tendency of the driving wheel to skid (after the control has turned the spindle through 90 degrees) will be very small, and the cut obtained will be somewhat as shown in Fig. 9. If, however, the machine is operated at high speed, it might tend to skid beyond its proper position, and the cut obtained would be somewhat as shown in Fig. 10.

Most normal cuts fall somewhere between the two extremes and will, therefore, produce the effect shown in Fig. 11, which consists of a slight rounding-off of the corner, plus a slight raised spot on the top surface of the cut. It should be noted that these drawings are enlarged and the error is exaggerated in order to show the results more clearly.

The effect of the two errors previously described is negligible. The distance from the center of rotation to the spot, is never more than $\frac{1}{8}$ in. and may be as small as $\frac{1}{16}$ or $\frac{1}{32}$ inch. If the distance between these two points were the maximum value ($\frac{1}{8}$ in.), then the error shown in Fig. 11 would be $\frac{1}{32}$ in. or less. In most cases, however, it will be found that the small projection located on the top flat surface of the cut will be partially burned off. Therefore, the error involved will usually be less than this $\frac{1}{32}$ in.

The diameter of the small spot of light on the paper is about $\frac{1}{16}$ in. By the time the spot has moved $\frac{1}{64}$ in. away from its correct position, well over half of the maximum available signal has been applied to the motor. This means that when following a straight or slightly curved line the error will usually not exceed 1/64 in. at the most. In actual operation, it has been found that these errors are well within the permissible tolerances for all work we have encountered. There are no cumulative errors.

Correction Proportional to Error

It should be noted that the control does not provide an "off-on" signal but instead provides a signal which varies smoothly as the spot is moved from its correct position to a position on either the black line or the white paper. Therefore, it provides a correction which is approximately proportional to the amount of error.

This type of control combines with the anti-hunt circuit included in the electrical circuit of the equipment to rotate the spindle around a corner much more rapidly than could be done by hand. The speed of rotation of the driving spindle when allowed to rotate freely is approximately 100 rpm — almost two complete revolutions every second—so that when the driving wheel approaches a corner it is turned to its new position very rapidly. This makes it possible to follow intricate shapes with very good accuracy.

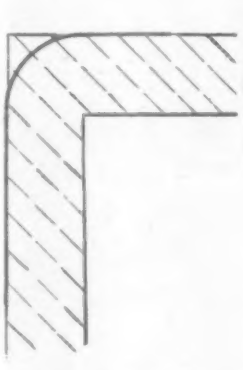


Fig. 9—Type of error produced at low speed.

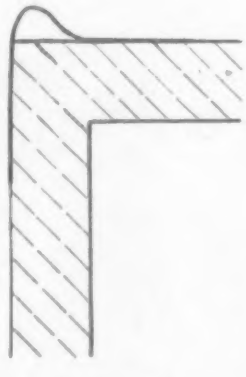


Fig. 10—Type of error produced at high speed.

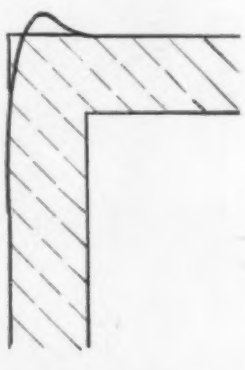


Fig. 11—Type of error produced at intermediate speed.

Welded Heat Ex

Plants now being erected to produce aviation gasoline and synthetic rubber call for large amounts of tubing specially made and tested for heat transfer purposes. Seam welding helps manufacturers to speed deliveries.

A VERY large demand has arisen for steel tubing for the construction of heat exchangers, condensers and other heat transfer equipment. This tubing will be needed in plants that are now being planned and erected as a necessary preliminary to the production of large volumes of synthetic rubber materials and aviation gasoline. The tubing requirements of the petroleum and the chemical processing industries are very much larger than they have been in previous years. Also, it is going to be desirable to have larger stocks of tubing available for replacement in existing petroleum and processing plants, since the maintenance of total production in these plants is obviously essential to the success of the war production effort.

The term "heat exchanger and condenser" tubes has become accepted by common usage as applying to tubing installed in all types of heat transfer apparatus; for example: heat exchangers, condensers, tank heating coils, tank car heating coils, tank unit heaters, after coolers, re-boilers, fuel oil heaters, feed water heaters, air preheaters, refrigerating apparatus, evaporators. Essentially, there is little or no difference in the function of the tubing in all of these devices, which are strikingly similar in construction and operation.

Codes and Specifications

The prewar period had witnessed a steady growth in the overall demand for welded tubing and a very rapid progress in the refinement of manufacturing processes. Satisfactory performance (over a period of years) of welded steel tubes for pressure and heat transfer purposes, that is, in heat exchangers, condensers, boilers, superheaters, etc., had led to adoption of specifications by code and specification writing authorities, including ASME, ASTM, the U. S. Navy, the Department of Commerce and others. The specification which is of special importance in this discussion is ASTM Specification A-214 for resistance welded steel heat exchanger and condenser tubes.

Method of Manufacture

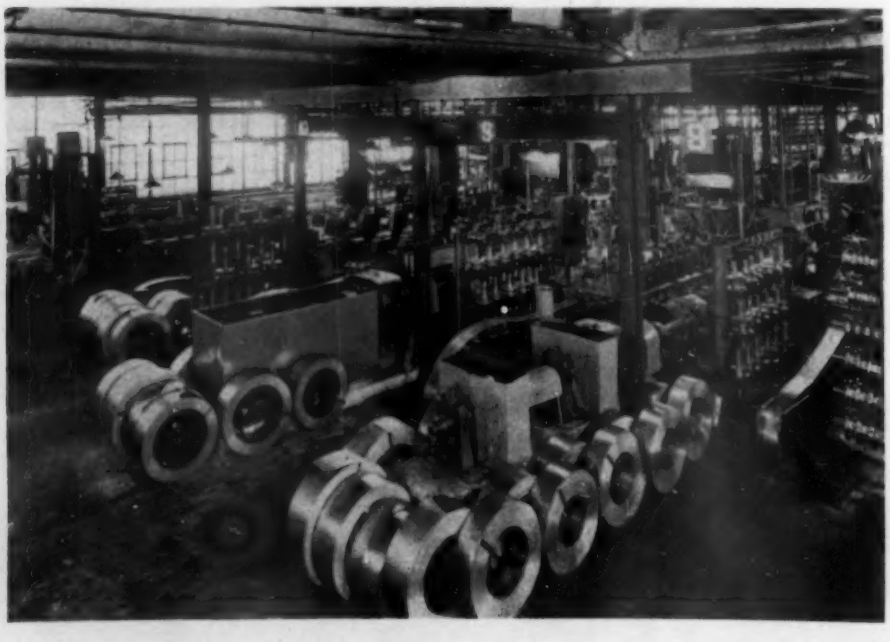
The inherent properties and advantages of welded heat exchanger tubing can best be made apparent by a brief description of the prevailing method of manufacture. The material used is flat rolled stock—generally received in coils from the steel mill where it has been accurately trimmed to whatever width is necessary for shaping to the required tube diameter. The process of rolling steel into coiled flat stock assures a high quality material of maximum strength, accurate gauge and excellent surface. Since the stock is of uniform thickness, the tube made from it will be inherently concentric, and no allowance has to be made for thick areas or thin areas when specifying dimensions.

The Forming Operation

The tube forming is done cold. The coiled flat stock is fed continuously through forming rolls which gradually shape it to circular form. Because both the outside and inside surfaces can be inspected nearly to the end of the forming operation, a complete check on the quality of the inside surface is provided while the material is still in the flat form. It should be noted that the cold forming process magnifies and does not hide any surface defects.

The coiled steel passes first through a pair of driving rolls and then through a series of forming rolls. At the beginning of the operation, the top and bottom forming rolls are opposite in contour, but the final forming rolls are of the same contour, top and bottom.

In passing through this series of rolls the stock is gradually curved until a cylindrical tube has been obtained. The butted edges are then welded together to make a continuous tube wall.



Coils of flat rolled stock ready to be processed into welded tubing. The ease with which the raw material may be controlled predetermines the uniform wall thickness and high quality surface of the finished product.

Heat Exchanger Tubing*

There are several different welding processes which may be employed to join the edges of the rolled strip together. These include gas, atomic hydrogen and resistance welding. Since ASTM Specification A-214, which covers carbon steel heat exchanger and condenser tubing, is specifically confined to tubing welded by resistance welding, we shall confine our discussion to this process.

Seam Welding Employed

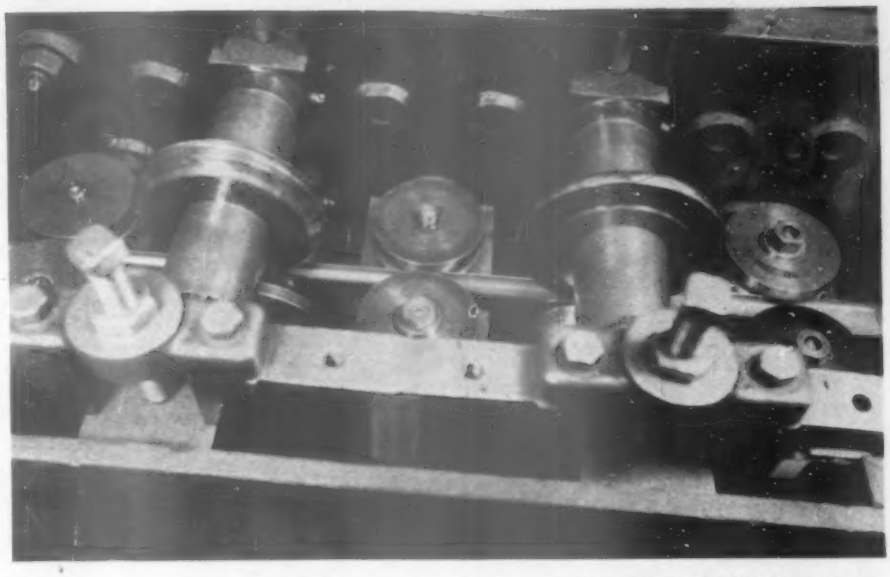
The welding unit consists of a high amperage current supply connected to a pair of copper alloy discs, which serve as electrodes and make a rolling contact with the two edges of the formed steel. When the tubing passes under the electrodes, current is automatically applied and travels from one electrode to the other across the seam cleft, creating heat through the resistance offered to the flow of the current by the edge surfaces.

As the current is being applied, the side rolls exert sufficient pressure to force the heated edges together and form a welded joint. The material at the extreme edges of the butted joint, which has been heated somewhat beyond the plastic state, is squeezed outward and the union is made with unexposed metal that is in the plastic condition. In other words, the edges are pushed together slightly beyond the actual closure of the seam in order to unite them into a solid and continuous tube wall. No extra metal is added in this welding process.

The important factors in the welding operation are current, pressure and speed of travel. All three of these factors are held uniform by automatic and extremely precise controls.

Weld Strength

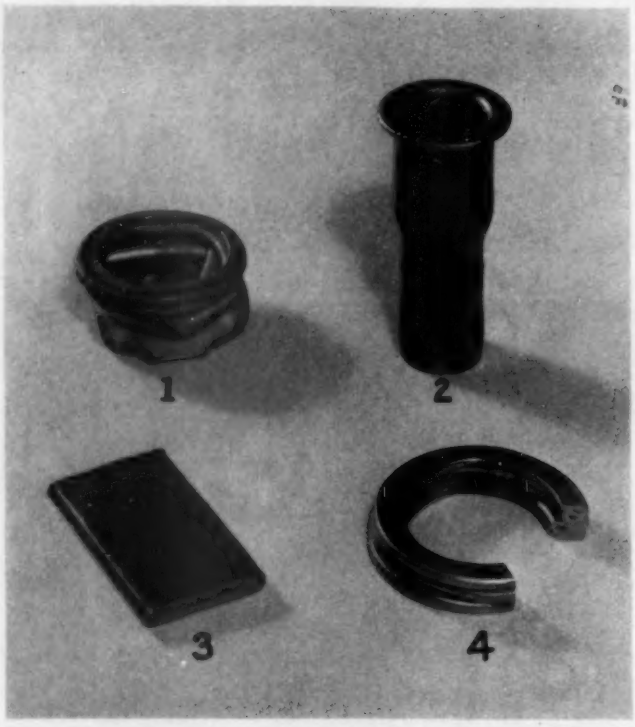
Questions naturally arise as to the strength of the weld produced in these operations. The petroleum industry and other chemical processing industries have answered these questions to a large extent out of their own experience, which includes the very widest use of welded equipment with a remarkable record of lack of weld failures. Nevertheless, it might be well to note at this point that the integrity of the weld area in welded steel tubing has been thoroughly established by scientific investigation as well as by practical usage. In 1929 the U. S. Bureau of Standards made an extensive series of tests on carbon steel tubing manufactured by the resistance welding process. The tests included tensile tests, axial crushing



The first forming rolls impart a slight curvature to the flat material. Note how easily the inside surface of the tube may be inspected at this stage. Subsequent rolls continue the forming until a circular section is obtained. Then seam welding wheels are employed to join the abutting edges together.

*From the "Manual of Welded Steel Tubing for Heat Exchanger and Condenser Use," a publication of the Formed Steel Tube Institute.

The first step in the manufacturing process is the feeding of the raw material from the coil through the driving rolls of the tube forming and welding machine.



Check tests of weld quality are required in the ASTM Specification covering resistance welded steel tubing for heat transfer use. These specimens show the results of: (1) crush test, welded stainless steel tube; (2) expanding and flanging test, carbon steel tube; (3) flattening test, carbon steel tube; (4) crush test, carbon steel tube, sectioned to show the extent of deformation.

tests, torsion tests, hydrostatic pressure tests, hardness tests, flanging tests and microscopic examinations of the weld areas. This testing program was sufficiently broad to include every physical and mechanical requirement which could be called for in heat exchanger tubing. The results were summarized in the conclusion that the weld is as strong as the rest of the wall and has the same qualities, as far as strength and other physical characteristics are concerned, as the steel from which it was made.

Welded Pressure Tubing

A very broad practical confirmation of these conclusions is found in the large use that is being made of welded steel tubing for applications which inherently require the utmost soundness and homogeneity of structure. Welded tube is accepted for use in boilers and superheaters under ASTM Specifications A-178 and A-226 respectively and for use in Navy boilers under U. S. Navy Specification 44-T-42. Welded steel tubing for oil, steam or water, with working pressures up to 600 psi, is accepted under U. S. Navy Specification 44-T-41. Similar specifications have been issued covering welded corrosion and heat resisting alloy steel tubing for heat transfer applications. Welded tubing is also accepted by the U. S. Army and Navy Air Forces for the exacting requirements of aircraft construction under Specifications AN-T-3, AN-T-4 and several others.

Control Tests

When welded tubing is manufactured to specifications which require one or more tests before shipment, it is customary to provide for a control or check test of weld quality immediately following the welding operation. The official test requirements for welded carbon steel tubing for heat transfer use are described in detail in ASTM Specification A-214. They include a flattening test, a flanging test, a hardness test and a hydrostatic pressure test. It is required that one flattening test and one flaring or flanging test shall be made on each of two tubes from each lot of 250 tubes. A hardness test is required on 5% of all tubes, and a hydrostatic test is required for each tube length.

The general procedure is to cut samples out of the production at regular intervals and to subject these samples to tests which will give definite assurance that the tubing being produced will pass all of the subsequent inspections and tests, and consequently be satisfactory for this application. Any failure occurring as a result of the control test is a signal to stop the mill and correct the cause of failure before resuming production.

Expanding and Flanging Test

A typical control test used during the production of heat exchanger tubing is to take a short length and expand it cold by the use of a suitable plug. When the outside diameter has been increased by about ¼ in., a ¼ in. flange is then superimposed upon the expanded portion. This test is rapid and simple and is severe enough to reveal any weakness in the wall of the tube. It also serves to establish proper values of current, pressure and welding speed for each size of tube.

Removal of Upset Metal

When the tube has passed beyond the welding rolls, it carries a very small burr or flash which is left on both the inside and outside by the welding operation. The outside flash is usually planed off with suitable cutting tools shaped to the contour of the tubing. It is not always necessary to remove the inside flash when the tube is to be used for heat exchangers or condensers. However, when special conditions make such removal neces-

Tubes are rough cut to length after welding. The cutting device travels with the tube so it is not necessary to stop the flow of material.

sary, it can be done by various methods. When the inside welding flash is removed, the tolerance standard is that the height shall not exceed 0.015 in.

It is generally necessary in the case of heat exchanger tubing to remove the inside weld flash for a distance of approximately 4 in. at each end of the tube. The specification requires that the height of the burr on the inside of the tube for a distance of 4 in. shall not exceed 0.010 in.

Cutting and Straightening

Welded tubing is commonly cut to length as it comes from the tubing mill. The cut-off machine moves with the tubing and automatically cuts it to specified lengths. This operation is usually such as to permit continuous operation of the entire tube forming and welding machine. There are several methods of cutting-off in common use. All of them require a finishing operation when a smooth end is desired, as in the case of heat exchanger tubing.

The tubes are passed through straightening machines for final straightening. The specification requires that the tubing shall be reasonably straight, in order to insure ease of insertion through baffle plates and tube sheets. After straightening, the tubes are cut to exact length and trimmed.

Hydrostatic Testing

The final testing operation for each length of tube is a hydrostatic test (at pressures depending upon the size and gauge involved) in accordance with Barlow's formula, based upon an elastic limit of 24,000 psi for normalized tubes and 35,000 psi for unnormalized tubes. Specification A-214 requires a minimum test pressure of 1,000 psi.

Final step is a hydrostatic test of each length. The test pressure depends upon the size and gauge involved, the minimum being 1,000 psi.

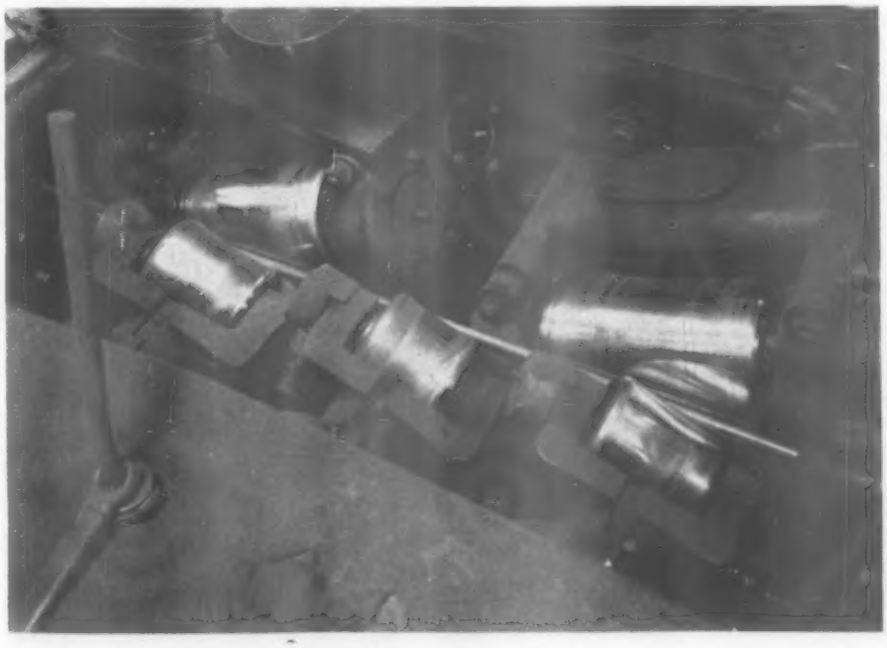
In addition to setting up special procedure controls governing the manufacture and testing of welded tubing for heat transfer use, manufacturers of such tubing consider it advisable to mark with a suitable symbol each length of tubing that is produced for this use. The purpose of this is to avoid the installation in heat transfer apparatus of any welded tubing which has not been specifically manufactured and tested for this exacting application. Each manufacturer has an individual symbol to use for the purpose of identification.

Inherent Advantages

The development of accurately controlled forming and welding methods has made the production of tubing in which the weld is as strong as the wall a routine procedure. No one who is familiar with uses of the resistance welding process in the manufacture of railroad cars, aircraft, automobiles and other dynamically loaded structures can question its suitability for making sound, strong, homogeneous longitudinal welds in steel tubing. That the control of weld quality should be precise and thorough is an economic necessity since failures under test would result in large scrap losses. Furthermore, the production of many millions of feet of welded steel tubing in which the weld area has been subjected to such operations as bending, beading, flanging, flaring and cold drawing sufficiently establishes the fact that weld quality control is being satisfactorily exercised on a mass production basis.

Defects Eliminated

Because the tube wall starts as clean, flat rolled steel, free from scale, and is subjected to inspection on both sides, welded tubes are free both outside and inside from such inherent defects as rolled-in scale, scabs and slivers. The forming rolls and pressure rolls are necessarily very accurate in size and highly polished. Therefore, they tend to have a burnishing effect on the outside surface. The process also makes it possible to hold very close tolerances in diameter and roundness, which will facilitate the passing of the tubes through header and baffle sheets.



The tube lengths are passed through the rolls of a straightening machine in order to meet specification requirements for straightness. After straightening, they are cut to exact lengths as specified by customer. This is not to be confused with the rough-cutting operation shown on page 54.

Welding Methods for Copper and Copper Alloys*

This paper deals predominantly with the fusion welding—not brazing—of copper and its alloys. In the installment published in the November issue of THE WELDING ENGINEER, *Mr. Vreeland discussed the welding of tough pitch copper and deoxidized copper by the oxy-acetylene and carbon-arc processes. The present installment covers the welding methods which may be successfully employed for the various brasses and bronzes.*

★ Part Two—The welding of copper and its alloys, the brasses and bronzes, has shown considerable advancement because of the increasing use of the carbon arc, coupled with the use of the silicon-bronze filler rod.

By **J. J. VREELAND**
Metallurgical Engineer,
Chase Brass & Copper Co.

High-Copper Brasses

THE welding of this group of copper-zinc alloys is best illustrated by the welding methods giving best results for red brass (85% Cu, 15% Zn).

Considerable brazing of red brass has been done in the past and described under the term "bronze welding." Using the popular yellow brazing rods, this method (previously mentioned in Part I) is a very satisfactory method of joining. Fig 9 shows a typical brazed joint on red brass. Tensile properties of this type of joint are very satisfactory, but the root-bend values are inconsistent. The sharp lines of demarcation between base metal and filler metal indicate a plane of weakness, which plainly shows up on a root-bend test.

Oxy-Acetylene Welding

Red brass standard pipe has replaced yellow brass standard pipe to combat corrosion failures. Yellow brass is subject to dezincification failures under certain unfavorable conditions; the same type of failure is possible when red brass pipe is joined by "bronze welding," but the failure in this case takes place at the joint. To overcome this type of failure, a welding rod containing a high percentage of copper has been developed for oxy-acetylene welding. This rod, a low silicon bronze, contains 1.5% silicon, 1.00% zinc and the balance copper. Its handling property under the torch is very satisfactory, since the weld metal is not so fluid, which property increases the tendency to braze. By maintaining a smaller pool of weld metal under the torch, a closer control is obtained, resulting in more assurance of fusion to the side walls.

In the oxy-acetylene welding of red brass pipe or plate in thicknesses from ⅛ to ⅜ in., inclusive, the edges to be joined must be beveled to a 45 deg single miter. Over ⅜ in. in thickness, best results are obtained by reducing the miter to 37½ deg, giving a 75 deg included angle. A flux specially designed for silicon-bronze gas welding should be used for best results. It is also suggested that the flux, mixed with alcohol to a thin paste, be applied with a brush to both the work and welding rods. Either a preheating torch or auxiliary torch is recommended for all gauges of ¼ in. and heavier. Fig 10 is a typical gas weld on ½ in. red brass plate, using a low-silicon-bronze rod.

Carbon-Arc Welding

Carbon-arc welding of red brass is recommended particularly when the welding can be done in a downhand position. The welding rod to be used for best results is a high-silicon-bronze rod containing essentially 97% copper and 3% silicon. A high-tin phosphor-bronze welding rod could be used with satisfactory results, but inability to cold work the joint would limit its use. Also the need of multiple bead welding for heavier gauges would give preference to the silicon bronze.

A slight preheating of all thicknesses heavier than 3/16 in. is recommended for best results. All gauges of red brass 3/16 to ½ in. inclusive should be beveled to a 45 deg single miter and welded with multiple beads. A 37½ deg single miter is recom-

* *Abstracted from a paper presented at the annual meeting, AWS, Chicago, Oct. 18 to 21.*

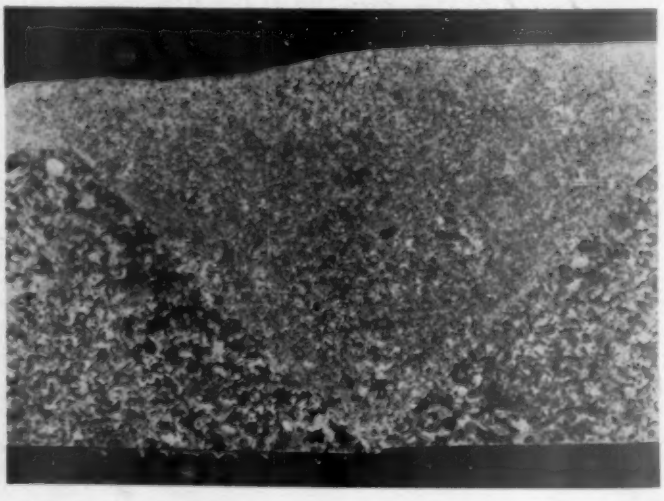


Fig. 9—A true braze on ½ in. red brass plate. Note the sharp line of demarcation between the brazing material and the base metal. Strength of joint, 30,000 psi; magnification 3X.

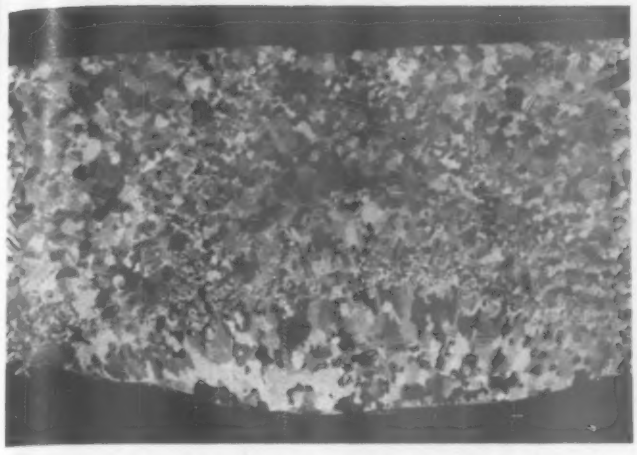


Fig. 10—A typical oxy-acetylene weld on ½ in. red brass plate, using a low-silicon-bronze welding rod. Note the uniformity of grain structure and the intergranular bond indicating fusion of weld metal and the base metal. Strength of joint, 37,000 psi; magnification 2½X.

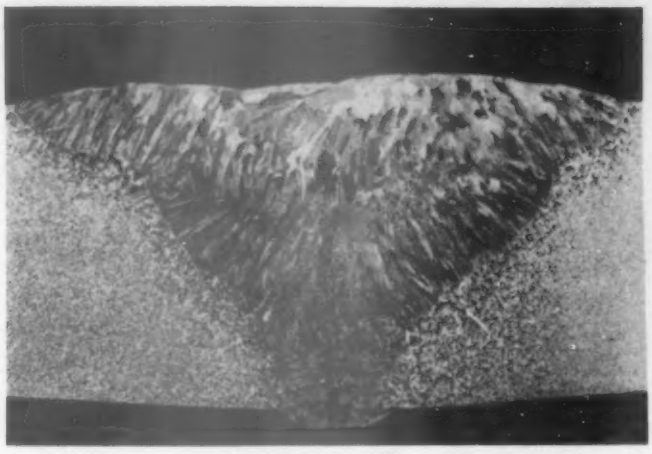


Fig 11—A carbon-arc weld on ½ in. red brass plate, using a high-silicon-bronze filler rod. Note the small effect that the welding has had upon the base metal. Strength of joint, 41,700 psi; magnification 2X.

mended for gauges ½ to ¾ in., and a 45 deg double miter for gauges over ¾ in. A grooved back-up bar should be used on thicknesses under 3/16 in. Regular silicon-bronze carbon-arc welding flux should be used and applied as a thin alcoholic paste to the work and welding rods.

Fig. 11 shows a carbon-arc weld of ½ in. red brass plate using the high-silicon-bronze rod.

Fig 12 illustrates the welding installation of red brass piping using the oxy-acetylene welding method and low-silicon-bronze rod. The installation required overhead and vertical-horizontal welding, which was easily done. The installation, involving 250,000 lb of piping with diameters from 4 to 14 in., was satisfactorily completed with a minimum amount of trouble and leakers.

High-Zinc Brasses

The welding of this group of copper-zinc alloys, which have copper contents from 58% to 80%, is essentially the same as that found successful for Muntz metal and naval brass.

Muntz metal (60% Cu, 40% Zn) and naval brass (59% Cu, ¾% Sn, balance zinc) are used commercially where welding fabrication can be successfully employed. These alloys have been extensively brazed, using silver alloy and phos-copper types of brazing materials, and oxy-acetylene welded, using the popular yellow brass brazing rods. For the welding application, the filler rods used can rightfully be termed yellow brass welding rods and the operation termed brass welding.

Oxy-Acetylene Welding

In the oxy-acetylene welding of these alloys using yellow brass rods (naval brass, manganese bronze, low fuming bronze), care must be taken by the operator to obtain actual fusion of the side walls of the base metal. The rods mentioned are not designed for welding applications, and if particular care is not given, a brazed joint is most likely to be obtained. A welded joint is superior to a brazed joint in ductility, particularly when root-bend values are compared. There is need for an alloy brass welding rod with lower fluidity than the present brass brazing rods which are used for the welding of low-copper-zinc alloys. Such a development would definitely be an aid to chemical equipment fabricators and to industrial piping concerns.

Carbon-Arc Welding

The carbon-arc welding of Muntz metal and naval brass is a recent development and is being used in the fabricating of distilling units and large diameter piping. The success of this welding completes the list of important commercial copper alloys to be commercially welded by the carbon-arc method.

The welding rod used can be either low fuming bronze rod or high-silicon-bronze rod. The high-silicon-bronze rod should definitely take preference because of the greater ease of handling during welding and the greater ductility resulting in the weld. In the arc welding of low-copper-zinc alloys, there will be a considerable evolution of zinc, but with the use of the high-silicon-bronze rod there is 75% less zinc evolution to contend with. The evolution of zinc is distinguished by the clouds of zinc oxide fumes around the welding operation. If these fumes are not removed by a suction pipe, they will interfere with the operator's vision as well as cause brass chills.

Using the high-silicon-bronze welding rod, excellent results can be expected at all times. Fig. 13 illustrates the structure of Muntz metal welded with a low fuming

Fig. 12—Welding a 10 in. diam red brass pipe in the overhead position. For this application, the oxy-acetylene method was used with low-silicon-bronze filler rods.

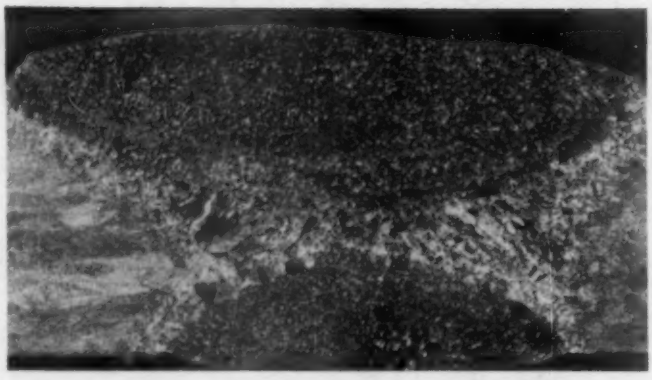


Fig. 13—A carbon-arc weld on ⅜ in. Muntz metal (60% Cu, 40% Zn) with a low-fuming bronze welding rod. Note the small granular structure of the weld metal. Magnification, 1¾X.

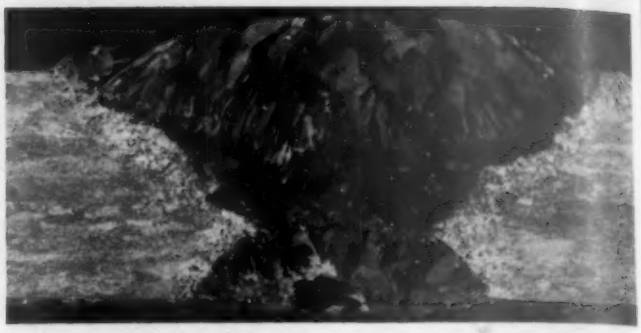


Fig. 14—A carbon-arc weld on ⅜ in. Muntz metal with a high-silicon-bronze rod. The large granular structure of the weld metal indicates greater ductility than the weld shown in Fig. 13. Magnification 1¾X.

bronze rod, and Fig. 14 illustrates the more ductile weld structure obtained by using a high-silicon-bronze rod.

Preheating of the base metal is essential in order to obtain proper fusion and soundly deposited weld metal. All gauges of metal thicker than ⅛ in. should be beveled to a 45 deg angle to minimize disturbance of the base metal. Multiple bead welding is recommended for welding thicknesses 3/16 in. and heavier. Particular care should be taken to chip out all crater cracks, particularly if low fuming bronze rod is being used. Flux should be used in the same manner as recommended for silicon-bronze welding; *i.e.*, thin paste with alcohol painted on the cold work before preheating and dry flux sprinkled on lightly after the work is hot. With a low fuming bronze rod, the flux should be a good brazing flux, but silicon-bronze flux should be used with the high-silicon-bronze welding rod.

Fig. 15 illustrates a set-up for fabrication of 3/16 in. thick Muntz metal into 14 in. diam piping by the carbon-arc method of welding. Preheating of the Muntz metal was accomplished by using a gasoline torch on the inside of the steel pipe backing on which the welding was performed. For girth welds, a removable back-up or chill strip is recommended to insure maximum weld metal density and added ease of welding.

Welding the Bronzes

There has been considerable information published on the arc welding of silicon bronzes (copper-silicon alloys), and it is not the purpose of this paper to discuss the welding of this type of alloy. There have been no new developments in this welding.

Phosphor bronzes can be satisfactorily welded by either the metal-arc or carbon-arc welding methods. A coated phosphor-bronze rod for metal-arc welding is recommended. For carbon-arc welding, the high-silicon-bronze welding rod gives better results from a weldor's standpoint than phosphor-bronze rod. Considerable trouble is encountered in keeping the highly fluid weld metal free from slag inclusions when using phosphor-bronze rod. The reason for this is the higher welding speeds that must be used with the more fluid weld metal, thus minimizing the time in which the slag particles can rise to the surface. Microscopic and X-ray examination reveals the slag particles at the weld junction. This trouble is not experienced with the high-silicon-bronze rod since welding speeds can be controlled so that the slag inclusions can be easily removed from the weld metal.

Aluminum and Beryllium

Aluminum and beryllium bronzes are very difficult to weld by the oxy-acetylene and carbon-arc methods if a welding rod of alloy composition similar to the base metal is used. Both alloys form highly refractory oxides which are difficult to slag off with flux. Aluminum oxide forms a light, tough web which becomes folded in the flowing weld metal and does not rise to come in contact with the molten flux on the surface of the weld metal. Satisfactory results can be obtained with the carbon-arc method, however, if a high-silicon-bronze welding rod is used. Aluminum and beryllium copper alloys are also being welded with excellent results by the metal-arc method with coated aluminum-bronze electrodes.

Oxy-acetylene welding of all of the bronzes mentioned should be avoided because of the various difficulties likely to be encountered. Carbon-arc welding should be given preference for all bronzes except those of aluminum and beryllium, for which the metal arc yields better results. Silicon bronze can be satisfactorily oxy-acetylene welded with high-silicon-bronze rods, but gas welding should only be used when the carbon-arc method is too difficult for the operator to handle. For all of the other bronzes (if arc methods cannot be used), brazing is suggested employing yellow brass or silver alloy brazing rods.

THE END

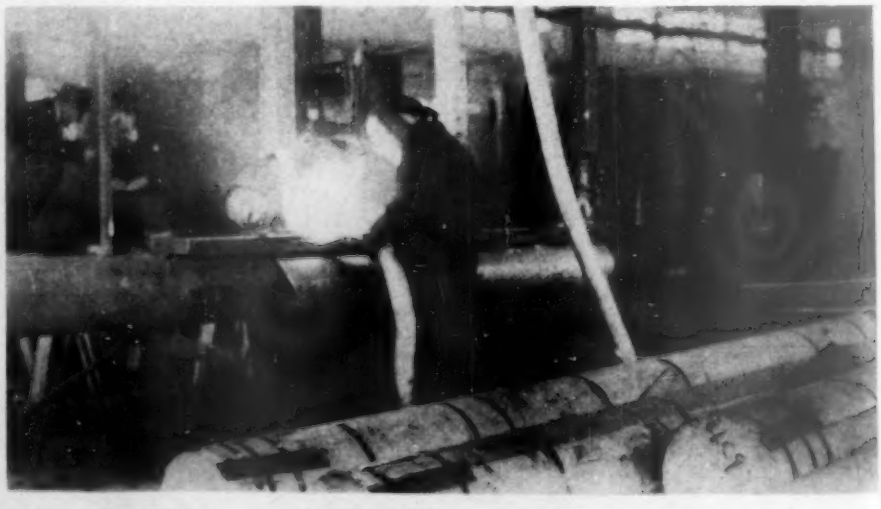
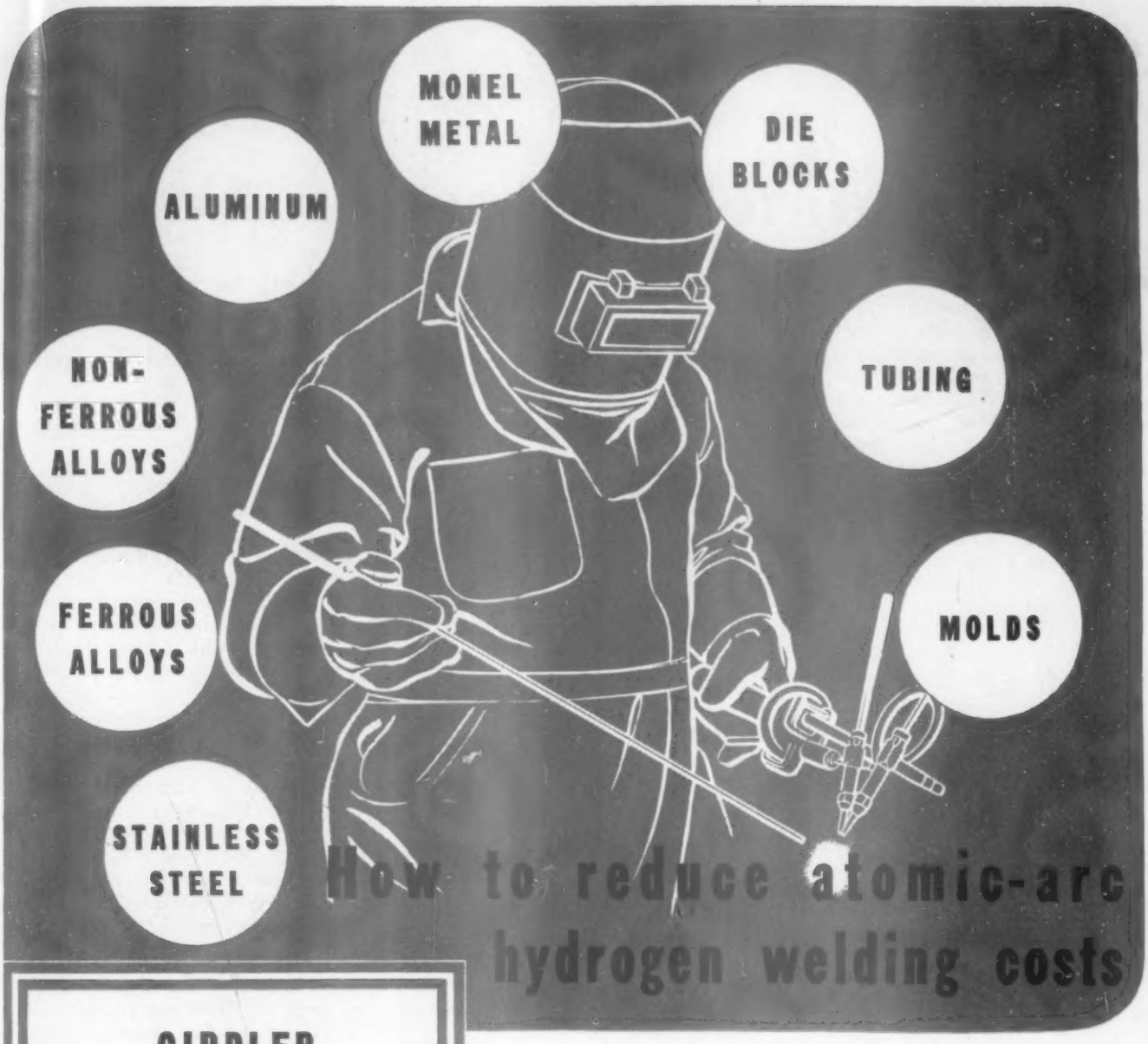


Fig. 15—Carbon-arc welding of ⅜ in. Muntz metal. In this application, high-silicon-bronze rods are used for the welded fabrication of 14 in. diam piping.



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Articulated Induction Coils

Induction heating is proving itself to be one of the most efficient methods of low-temperature heating for the preheating and stress relieving of welded piping.

By **ROBERT CLEELAND**

THE INCREASING demand for welded piping capable of withstanding the high temperatures and pressures of power plant service has brought about a need for portable stress-relief equipment that can be quickly set up in the field and accurately controlled. Induction heating (almost entirely in the form of heavy cable winding) has been used to some extent for this purpose, but difficulties of set-up and handling have hitherto restricted its more widespread use. Most of these difficulties, it is believed, have been removed by the development of fixed articulated coils having graded heating capacities based upon standard pipe sizes.

These coils operate through transformers from a standard 60 cycle power line. They are specifically designed for flexibility and handling ease, provide the added improvement of unvarying uniformity of pitch and coverage and will make available a rapid, clean, accurately controlled heat. Thoroughly engineered and field-tested over a period of six years, these fixed articulated coils should be able to accommodate almost all of the stress-relieving problems encountered in the installation of high-temperature, high-pressure piping.

The coils are made in five standard sizes. These, together with other operating data, are listed in Table I.

Heating Factors

Induction heating is an application of two principles: that electric currents are induced in a metallic body by means of a surrounding coil carrying an alternating current and that these currents will heat the body, which becomes, in effect, the secondary of a transformer short circuited upon itself. The attainable temperature and heating rate depend upon a number of factors: the power input, frequency, closeness of coupling between the coil and the body, the nature and mass of the material to be heated and the efficiency of the thermal insulation.

The heating effect is related chiefly to the number of ampere-turns in the coil's magnetic field. A coil of comparatively few turns has been found to be the most satisfactory design, provided that it has a large radiating and cooling surface and is of sufficiently large cross-section to carry the necessary heavy current. The operating voltage across the coil may be quite low (20 to 30 v). Standard transformers are available which readily adapt themselves to this service.

Not a Heat Source

Naturally, the coil is heated to some extent by its internal resistance, but it is not a heat source in the conventional sense of the term. Induction heating differs from all other types of heating in that the heat is neither radiated nor conducted from an external source but is generated entirely within the object being heated, in this case the walls of the pipe. It is difficult for the layman to understand how heat can be made to appear inside an object without traversing intervening space, but for the engineer the apparently mysterious process has many practical advantages. One advantage, in this instance, is that the induction coil may be entirely clear of the pipe, allowing the latter to rotate freely all the while it is being heated.

Heat Insulating Sleeve

To minimize the transfer of heat by radiation from the piping wall to the comparatively unheated coil, a sleeve of thermal insulating material is inserted between the pipe and coil. This serves the two functions of conserving the generated heat and helping to cool the coil. The sleeve, of course, is no barrier to the passage of the induced currents.

Fig. 1—The 6 in. coil and insulating sleeve as assembled for either preheating or stress relieving on a length of 6 in. pipe.

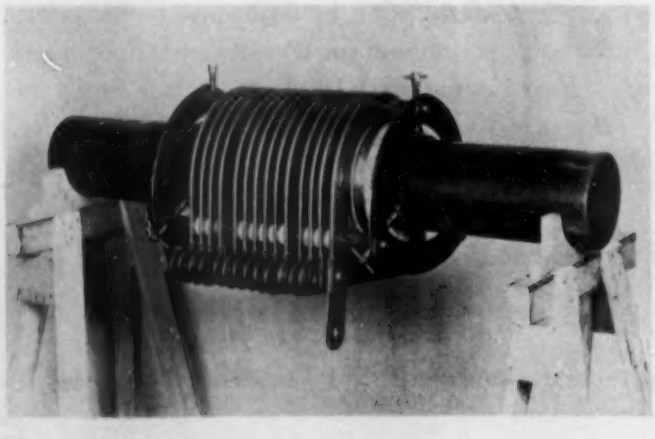
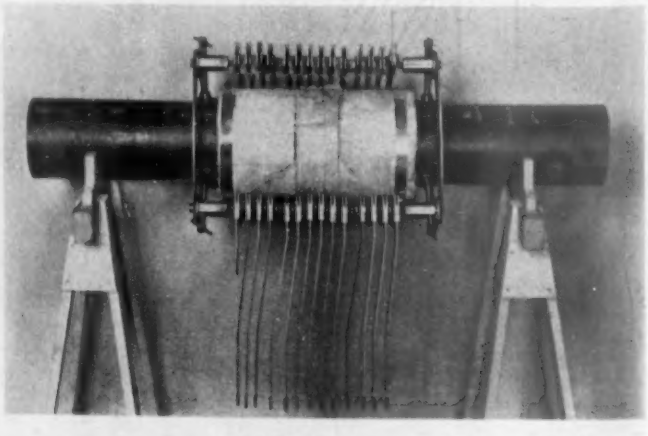


Fig. 2—Switch blades in the open position preparatory to mounting or dismantling.



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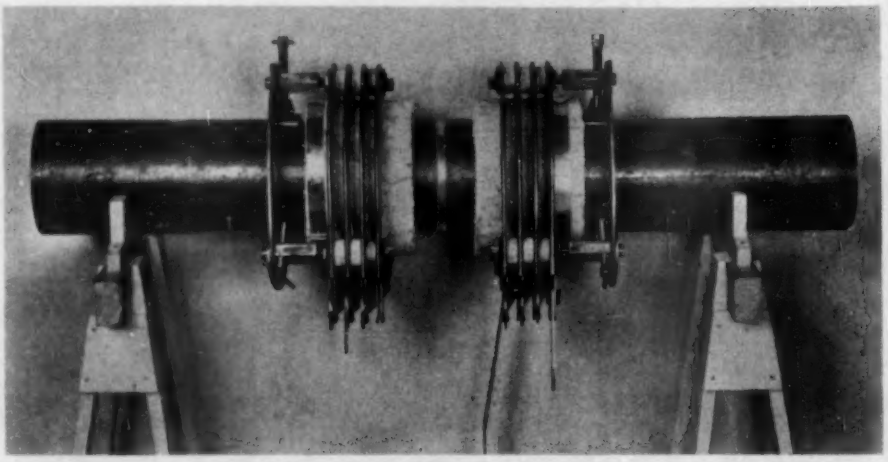

Fig. 3—Coil with middle section removed for welding. The missing section is slipped back in place after welding, to provide stress-relief heat.

The application of pyrometric measurement and control is particularly simple, and the measured temperatures are probably the most reliable obtained in any type of heating owing to the fact that the measuring thermocouples are affected only by the heat in the pipe. Records, therefore, are free of sources of error. The temperature control may be made wholly automatic, using the off-on system of input control. Even under adverse conditions, a temperature tolerance of plus or minus 50 F may be readily maintained over a long soaking period.

The coils are sufficiently versatile in application to be adapted to nearly every case in which a flexible cable winding could be used, and they will save considerable time over the laborious and lengthy hand-winding cable process.

Coils Air-Cooled

The other advantages which the fixed coils possess over hand-wound cable are uniformity of pitch and a large cooling surface. The former insures uniform heat and easy standardization, and the latter reduces the power loss due to the increase of resistance with temperature as the coil heats up. The temperature of the coil should not exceed 200 F in an ordinary shop set-up, even though the temperature of the work may be in excess of 1,350 F.

Rapid set-up, reliability and safety should all be mentioned as additional advantages. The coils are rugged and durable and should require no replacement nor maintenance unless subjected to gross abuse. The articulated construction reduces the weight of the unit, and the low operating voltage (20 to 30 v) renders it comparatively free from electrical hazards. Under most field conditions, the coils and insulation may be set up by one man in a few minutes.

Preheating and Stress Relief

Preheating and postheating (stress relief) of welded joints are required in nearly all codes regulating the construction of high-pressure, high-temperature alloy steel piping and in similar applications in which the weldment must be metallurgically sound and free from internal stresses. Preheat temperature is usually stipulated to be between 200 and 500 F and stress-relief temperature as between 1,100 and 1,250 F. The standard coil design is based on these requirements.

A single set-up permits a complete operating sequence involving preheating, stress relief and, if desired, auxiliary heating during the actual welding. The coil and insulating sleeve (Fig. 1) are in three sections. The screw clamps, shown tightened in Fig. 1, are used principally to allow the coil to be used in a vertical or inclined position; they are readily removable to permit the coil to be rested directly on the insulation in a horizontal position. In Fig. 2, the switch blades are shown in the open position for mounting.

The pipe may be brought up to preheat temperature in a few minutes with the recommended transformer equipment. Immediately before welding begins, the central coil-and-insulation section is removed, leaving the joint exposed as shown in Fig. 3. The removal of this section provides ample welding space for the operator. When the weld is completed, the central coil and insulating sleeve are slipped back into place and the stress relief heat is begun.

Heat during Welding

Should conditions require the maintenance of auxiliary heat during welding, a short jumper of cable may be connected across the gap and the end sections of the coil; this will serve to supply whatever heat is necessary to keep the joint temperature up to the required minimum. The power input, it should be noted, is independent of the number of coil turns in service; the removal of some of the turns merely has the effect of increasing the amperage in the remainder.

If it is desired to rotate the work to facilitate welding, an independent support may be provided under the flat side of the coil, holding the latter so that the work may be continuously rotated within it.

Joints other than those between straight lengths of pipe require variations in the basic set-up. For tube-to-flange joints, an end section of a larger coil is used over the flange. This is fitted with a short jumper and a step-down conversion ring by which it is attached to the remainder of the coil.

For tube-to-elbow joints, the screw clamps should be removed or turned out of the way and the coil rested directly on the insulation. For elbow-to-elbow and other joints in which the mounting space is smaller than the length of the standard coil, parts of the coil may be used separately in the manner most convenient.

Table I. Characteristics of Standard Coils

Nominal IPS, In.	Actual ID, In.	Weight, Lb Total	Weight, Lb Center*	Approx. Length of Covering, In.	Pitch In.	Current, Amp	No. of Turns	Recommended Transformer Equipment
4	7¼	65	25	12	¾	800	12, 4-4-4	Two 5 kva†
6	9⅜	125	55	13	⅞	1,000	14, 4-6-4	Two 5 kva†
8	11⅜	175	85	15	1	1,000	14, 4-6-4	Three 5 kva†
10	13¾	200	95	17	1⅛	1,200	14, 4-6-4	Three 5 kva†
12	16¼	225	100	18	1⅛	1,200	14, 4-6-4	Three 5 kva†

*Heaviest section

†Primary in series, secondary in parallel

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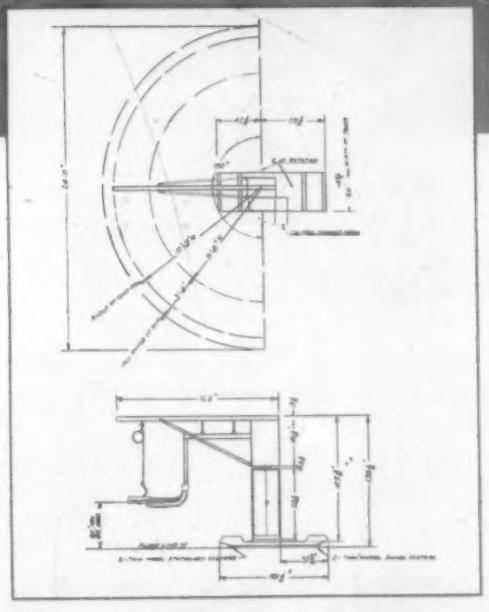

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Bending and Shrinkage Assembly

The technical problems involved in bending pipe and for shrinkage assemblies of tubes require temperatures of similar order to those used in stress relief; *i.e.*, from 1,000 to 1,500 F. The standard coils and transformer equipment will therefore be found satisfactory for many applications of this type, and the same set-up may be used as in stress relief.

A number of standard coil units may be used for tubing that must be heated over a considerable length. Even on well insulated pipe, the temperature gradient in the tube on either end of the coil is so abrupt that a space of not over 1½ times normal pitch is the maximum allowable for a temperature tolerance of plus or minus 50 F. For such applications, the screw clamping gear should be removed and shorter mounting bolts substituted. The coverage of the coils is given in Table I.

The individual coil turns are interchangeable; theoretically, as many turns as desired may be mounted as a single coil unit, but in practice this number is limited to from 10 to 20, depending on the size, by considerations of power input and ease of handling.

Current Source

Where a single- or three-phase, 60-cycle power line is available, the recommended current source consists of one or more air-cooled service transformers. For reasons of portability, a number of 5 kva transformers have sometimes been found preferable to a single multitapped transformer of larger capacity. A 5 kva unit equipped with carrying handles may be transported by two men. Three 5 kva units operated with primaries and secondaries in parallel provide ample output to stress relieve a 12 in. joint.

To avoid unnecessary induction losses, the secondary lead should be kept as short as possible and clear of metallic objects. The transformer and switches may be conveniently mounted together. A 200 amp magnetic switch and, preferably, a single throw 200 amp fused safety switch installed on the primary line are all the equipment necessary for manual control.

Temperature Control

Most fabricating codes specify a maximum heating and cooling rate and a definite holding temperature for stress relief. Temperature measurement and control are necessary because the heating rate of the recommended coil and transformer set-up is considerably greater at full output than the allowable maxima. The mode of input control may be manual, semi-automatic or automatic, depending on the control instruments available.

The best heating-rate control is an input regulator which operates in conjunction with the magnetic switch to pass the primary transformer current intermittently. In automatic and semi-automatic control systems, the input regulator operates in conjunction with pyrometers activated by thermocouples attached directly to the tube joint. Full automatic program control can be obtained by this means.

Usually, a recorded graph of the entire heat program is also necessary. In general, it is desirable that any type of automatic control be independent of the recording instrument; however, instruments which both record and control are available.

Coil Specifications

The coils are cold formed from hard drawn copper tubing. The insulating spacers are made of porcelain faced with washers of asbestos composition. Each coil section is assembled on three steel through-bolts.

Coils are furnished, complete with clamps and terminal bolts, in the sizes given in Table I. The nominal size is the iron pipe size (IPS) for which the coil is designed; this allows approximately 1½ in. clearance for thermal insulation. Special sizes may be made as required.

★ ★ ★

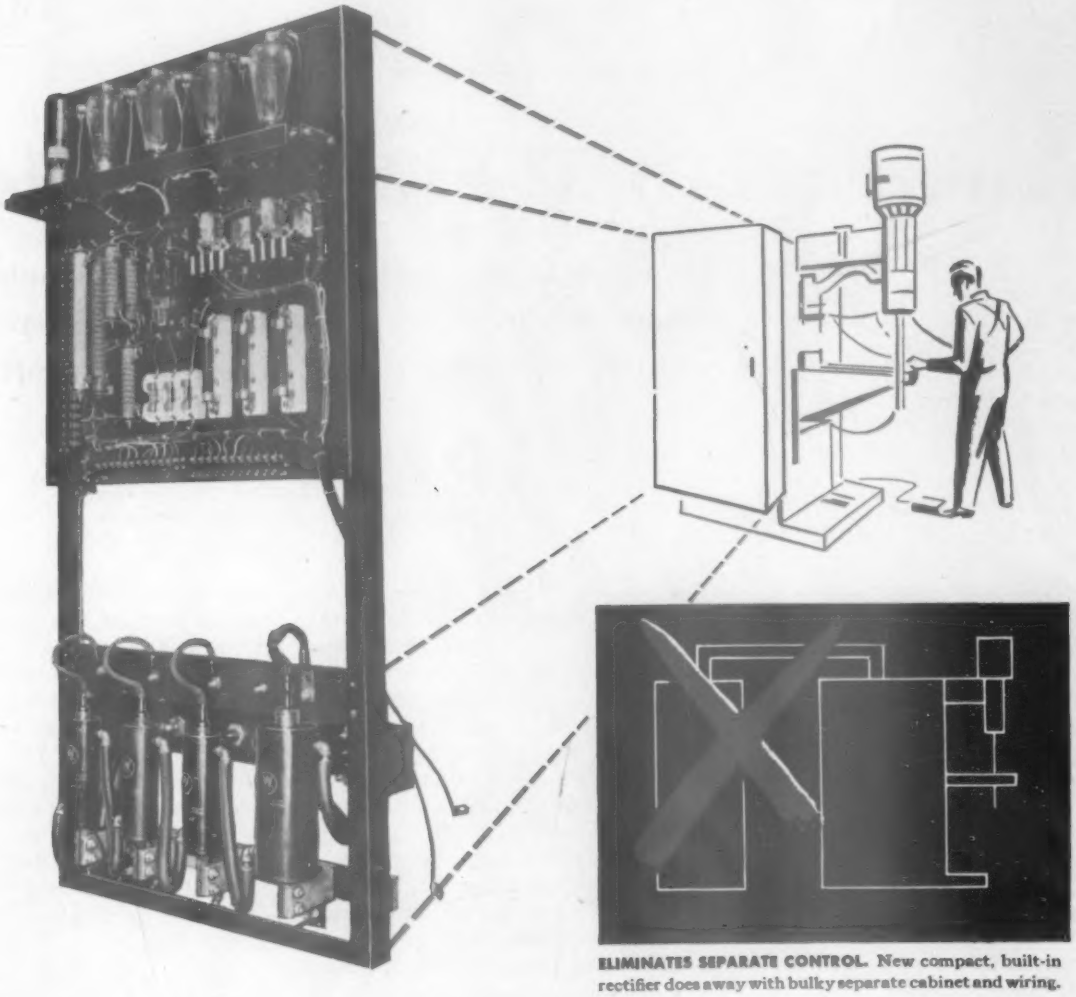
First and Last

THE PICTURES below show the first (left) and the last welds made in the construction of the "Big Inch," 1,400-mile line of 24 in. seamless piping. From the initial bell hole weld to the final tie-in, welding played the leading role in the construction of this 95 million dollar oil pipe line from Longview, Tex., to the Philadelphia and New Jersey refining areas.

In operation since July, the "Big Inch" is now delivering some 300,000 bbl of oil per diem to the oil-starved east coast. The line is estimated to be able to hold 4,000,000 bbl—as much as all the oil wells in the United States can produce in one day. The world's longest pipe line of its size, it is capable of transporting as much oil as can be carried by 85 tankers.

Photos, courtesy The Lincoln Electric Co.

Electronics at Work



ELIMINATES SEPARATE CONTROL. New compact, built-in rectifier does away with bulky separate cabinet and wiring.

Another example of Westinghouse electronics leadership is a new built-in rectifier that supplies power for energy-storage resistance welders used in aircraft fabrication.

The new rectifier permits combination of welder and controls into one smooth working unit . . . completely eliminates the separate control cabinet formerly required . . . eliminates lengthy, bothersome wiring between welder and controls.

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*Registered Trade-mark, Westinghouse Electric & Mfg. Co. for HIgh PERmeability SILicon steel.

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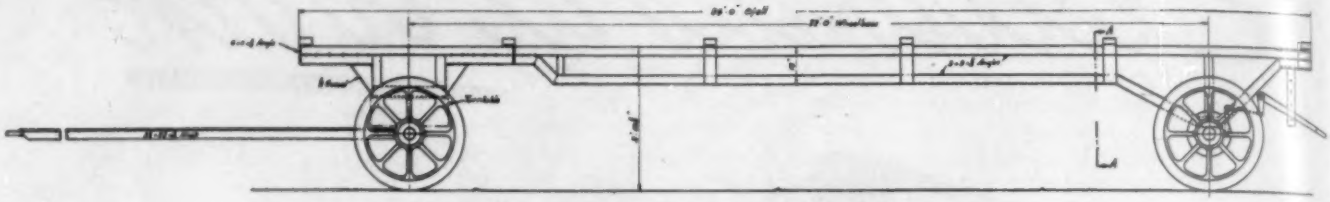


Fig. 1—Overall view (elevation) of welded steel trailer.

Australian Welded Trailer

From the land of the kangaroo and the kookaburra bird comes this interesting account of the construction of a 28 ft. all-welded carrier to speed transport of rails.

By **ALFRED J. THOMSON***
Engineering Draftsman, City Council Transport Dept., Brisbane, Australia

THE ALL-WELDED steel rail carrying trailer shown in Fig. 1 was constructed to supersede an old type having a timber frame fitted with artillery wheels, in order to speed up the transport of rails. Although designed primarily for rail carrying, this trailer has also proved useful in the hauling of timber and structural steel. The vehicle has been in continuous operation for 12 months and has given excellent service, with greater safety and saving of time.

The trailer is towed by a tractor fitted with the crane which is used for loading. The old type was capable of a maximum speed of only ten miles per hour, and its wheels used to run hot frequently because they had only sleeve bearings. It was proposed to mount the new trailer on solid rubber tired wheels fitted with roller bearings.

Due to the severe conditions of service, the new design was approached with some diffidence. Some criticism was made on the grounds that an arc welded frame would be too rigid as compared with the old timber frame. It was pointed out that the frame is subjected to severe stress and strain in service due to the long wheel base and to the fact that the trailer travels over rough terrain such as excavations.

A 7 Ton Load

The maximum load to be carried was fixed at 7 tons, and this figure was used for design purposes. Since our local highway regulations govern the size of wheels used on solid rubber tired vehicles, we were restricted to wheels of 36 in. diameter front and rear. This made it necessary to step up the frame to allow the front wheels to turn in a complete circle and thus enable the vehicle to turn in its own length.

To arrive at the size of sections, it was assumed that a load of 3½ tons would act on each pair of wheels (the weight of the frame was neglected) and that point loads totaling 3½ tons would act on each cross member. In actual practice, it was found that the rails did not deflect and that there would be little or no load on the cross members.

Use Flat Bars and Angles

A preliminary set-up showed that two 3 by 3 by ⅜ in. angles spaced 12 in. over the flanges would give a very satisfactory test as regards deflection and flexibility; accordingly, these sizes were used in the final design. The crank-effect of the bottom member at the ends and at the turntable produced a section equivalent to a 6 by 3 in. channel when the legs of the angle had been double vee butt welded at these points. The welds were relied on to take the longitudinal shear, and from approximate calculation they proved to be adequate. The struts (Figs. 2 and 3) were made out of ½ by 3 in. flat bars fillet welded to the legs of the 3 by 3 in. angle.

The cross members are 4 by 4 by ⅜ in. angles 7 feet long. The bottom leg was cut to fit over the top angle of the side member (see Figs. 2 and 3). These cross members are cantilevered over the main frame just enough to clear the wheels and so protect them

* From a paper submitted in the Industrial Progress Award Program sponsored by The James F. Lincoln Arc Welding Foundation.

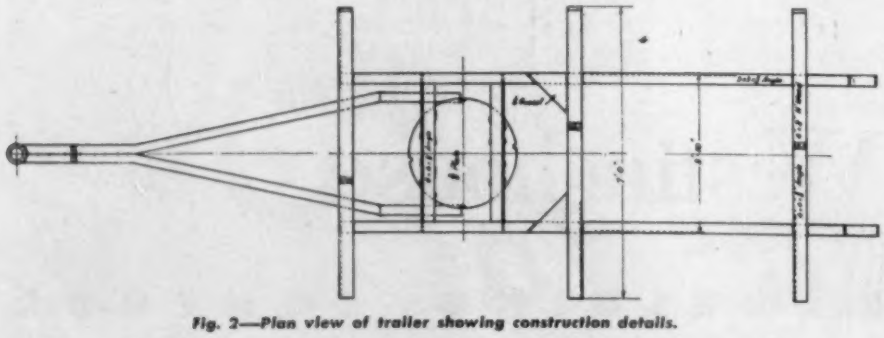
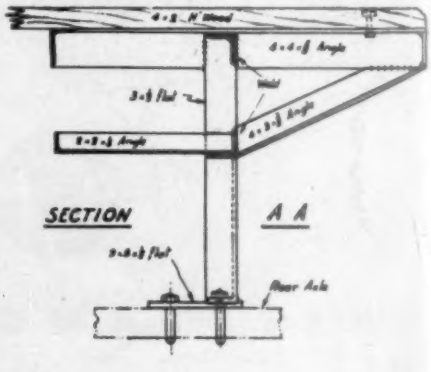


Fig. 2—Plan view of trailer showing construction details.

Fig. 3—Rear axle and strut arrangement showing position of the welds.



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when unloading the rails. The cantilever was braced on to the bottom side member, and a 2 by 2 by ¼ in. angle tied the two side frames together at the bottom.

The two end cross members were cut from 6 by 4 by ½ in. angles as shown in the accompanying sketches. As no springs were used, the frame bolts directly to the axles.

Welding Procedure

The side frames were first marked off, cut and tack welded together. Cross members were then fitted in place and tack welded to the frame. Next, the side frames were completely welded together, starting with the 3 by ½ in. flat members. The only sign of distortion resulting from this procedure was a slight buckling of the top member, which was easily straightened. We used a large-sized mild steel electrode wherever possible in order to produce a dense, flat bead.

The wheels and turntable were purchased as standard equipment. The accommodation for the turntable required only ½ in. plate welded to the frame. The towing arm had to be made long enough to clear the overhangs of the rails. The cross members were drilled to take hardwood stringers, which served to reduce the shock of loading and helped avoid rail slippage when on a grade. A hand brake was installed to operate on the rear wheels, which were fitted with 12 in. diameter brake drums.

Cost Comparison

In arriving at a fair basis for cost comparison, it is necessary to consider that a timber-frame job would also have been fitted with the same type of wheels, tires and turntable. These items cost $948.60.

Shop charges for the complete fabrication of the steel-frame trailer came to $330.48 compared to the price of $398.50 recently obtained for the construction of a timber frame without springs. As springs would be necessary for this type (though eliminated on the welded trailer), an addition of $55.80 would be required, making a total of $454.30. The net saving on the welded job is, therefore, $123.82. However, the cost of the welded frame could be cut by at least 5%, we estimate, if a quantity of them were to be required.

The fabrication in steel by any means other than arc welding would have been impracticable because of the extra weight of the sections and the complication of the joints. This design demonstrates in a practical way the advantages and greater scope of arc welded over riveted construction.

★ ★ ★

Welded Chains Boost Steel Output

Photos, courtesy of The International Nickel Co., Inc.

Substitution of welded Monel chains for chains of cast alloy material made possible the use of this mechanical pickler, which cut down pickling time in a large steel mill from six hours to two hours. The welded chains have an average life of 1½ years as against the 2½ months in which the cast chains could be used. They operate 24 hours a day in a 10% solution of sulphuric acid at 150 to 165 F.

PICKLING steel products in a dilute acid solution in order to free their surfaces from rust or scale is a common operation in steel plants. The headache, from an engineering standpoint, is that a solution sufficiently powerful to clean the steel properly is sure to play havoc with whatever metal parts there may be on the pickling machine.

Before the war, one of the nation's largest producers of alloy steel had been using cast bronze alloy chains in its pickling operations. Welded chains of corrosion-resistant Monel were substituted, with a view to shortening operating time and cutting down repairs. The results were amazingly good.

First, the substitution helped to make possible the installation of mechanical picklers that reduced the time required for pickling from six to two hours. This was not all, however. The cast chains had been in the habit of failing in about 2½ months. The welded chains, experience has showed, will last on an average of 1½ years—just about seven times as long. The time formerly required for chain replacement and repair may now, to a large extent, be devoted solely to production. Finally, the cast chains gave an objectionable copper flash which has now been entirely eliminated.

The Monel chains, made by the Youngstown Welding and Engineering Co., operate in a 10% solution of sulphuric acid at temperatures ranging from 150 to 165 F. (Heated sulphuric acid is much more active than when cold.) They are in service for 24 hours out of every day. Each set of chains handles an average of 20,000 tons of SAE 4615 and other nickel alloy steels during its lifetime. The average load is 10,000 lb. Tubes and bars which vary in size up to 6 in. diam by 20 ft long are handled in this mechanical pickler.

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On the Job

Snow Bucket from Scrap

WHERE a large crew of men were once forced to spend three or four days in removing snow by hand from the yards of the Dow Chemical Company's Cliffs plant in Michigan, one man now does the same job in a single day. The snow bucket which makes this appreciable manpower saving possible was constructed entirely from salvaged materials. No new steel was used.

Completely fabricated by arc welding, the bucket measures 72 in. across, 42 in. high, 46 in. deep and holds approximately 1¾ cu yds of snow. The dogs that hold it are released by a cable running back to the tractor driver. After the snow has been dumped, the driver lowers the bucket to the ground and backs up. This snaps the dogs into place, and the bucket is ready to load again.

Cost of this all-welded bucket was $127.85, including $85.54 for welding and preparation, $35.31 for material and welding electrodes, $7 for painting. A riveted bucket of equal capacity would have cost in the neighborhood of $600.

This welded bucket was also considerably lighter than a riveted one would have been, allowing larger amounts of snow to be handled at each load.

Photo, courtesy The Hobart Brothers Co.

This all-welded snow bucket which can scoop up 1¾ cu yd of snow at a time cost but $127.85 as against the $600 or so that would have had to have been spent for a bucket of riveted construction.

» «

Feedwater Heater Welded

ORDINARILY, the shell of a feedwater heater is made in one piece. However, Elliott Co., Jeannette, Pa., was given an order for a deaerating feedwater heater that was too big to go through any of the available openings existing in the power plant of a large automobile factory.

This heater was to be installed as part of the expansion necessitated by a conversion to war work, so the problem of elevating it over outside coal bunkers and carrying it in through a steel window frame only 6 ft high and 18 ft high had to be solved somehow. Engineers of the Elliott Co. met the challenge by designing a unit in three sections which could be welded together inside the power plant.

The accompanying picture shows the middle section of this 350,000 lb per hr horizontal unit, revealing the bracing, baffles, overflow pipe and steam inlet connection. The heater was installed in the customer's boiler room at considerable elevation above the pump, where ample room was available.

A workman grinds a weld on the middle section of a deaerating heater designed in three sections by the Elliott Co., Jeannette, Pa. The final welded assembly was done in the customer's power plant.

» «

Tool Demagnetization

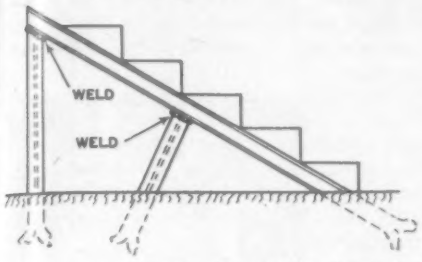
AMERICAN ingenuity being what it is, arc welders are often used for other purposes than the fabrication of metals for which they were designed. Among these "unofficial" chores is the use of D-C equipment for thawing out pipes and for warming up airplane engines on cold mornings. Now the use of A-C welding transformers for demagnetizing steel parts is reported by R. F. Wyer, welding engineer of the General Electric Co.

The method is said to be similar to that employed by jewelers in demagnetizing watches. The A-C welder was first used for this purpose by E. L. Bailey, electrical engineer at the Chrysler tank plant in Detroit, to remedy trouble caused by metal parts clinging to dies which had become magnetized. Five or six turns of cable were wrapped around the die, and a heavy 60 cycle current from a 500 amp welder was passed through the cable. The current was then gradually decreased by turning the "stepless" current-control crank on the welder. This procedure is now regularly employed at the Chrysler plant.

Today's widely expanded use of highly hardenable alloy steels has brought to light numerous instances where permanent magnetism is causing trouble in the operation of tools. Chances are good that A-C welders are going to find a good bit of extra work along this line.

Argentine Welding Job

FROM far off Buenos Aires, leading metropolis of the Southern hemisphere, Pablo J. Barresi writes to tell how he used his welding skill to repair a football field grandstand that had broken down because of faulty construction.



Courtesy, The Lincoln Electric Co.

Sketch showing how grandstand supports were arc welded to replace the former inferior method of riveted construction.

The structure repaired consisted of three I-beams. One beam was placed as a vertical support; a second was placed as a support in the middle of the stand, at an angle of approximately 30 deg from the perpendicular; the third was placed in a slanting position and supported the planks of the grandstand. These supports were joined with 2 in. by ¼ in. plates, each union having four rivets.

"I fixed the grandstand by welding the unions, thus eliminating the rivets," reported the Argentine weldor. "The job has been found to be very satisfactory, and the stand now offers greater safety."

» «

Blind War Workers

TWO WAR WORKERS, one completely blind and the other with partial vision in one eye only, are doing a remarkable production job at American Welding & Mfg. Co., Warren, O. They operate a drill press and have a very fine record—comparable to that of normal employees.

Frank Webber, who had the misfortune to lose his eyesight twelve years ago, had operated a drill press in the last war and welcomed the opportunity to bring his old skill to bear in behalf of the production effort for this one. After a three-hour trial, he and his friend, George Frank, were both put on the company's payroll.

George Frank, the other half of the team, uses his limited vision to help his partner get around the shop and to perform the operations that require some sight. Working with the same tools and gauges employed by other operators, these two men turn out tank turret rings which must check within 0.005 in. A delicate sense of touch is Webber's principal asset.

Webber was a farmer and an automobile mechanic before he became blind at the comparatively young age of 35. He continued to make a living by repairing automobiles, working wholly by his marvellously developed sense of touch. In addition to his work for American Welding, he now farms a three-acre Victory garden with the help of one son and an old tractor which he built himself.

Frank lost the vision of one eye in 1916 but continued to work in a steel mill despite this handicap until the last depression.

Frank Webber, right, is the totally blind drill press operator at the plant of the American Welding & Mfg. Co., Warren, O. George Frank, Webber's helper, has partial vision in one eye.

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Unique Fuel Tank

By CHARLES C. LYNDE

TO PROVIDE a fuel supply greater than the small tank with which a portable motor-generator set had been equipped, the weldor for a drilling contractor revised the design of the combination skid and guard frame in which the units were mounted for field service.

The entire frame was converted into a fuel container by simply welding the various pipe sections together in such a way that a continuous liquid-tight passage was provided. By setting a ¼ in. nipple in the cross member carrying the generator, it was possible to mount a valve and tie in a suction line to the fuel pump. For filling, one corner post was permitted to extend through the penthouse roof (see illustration) and was capped with an ordinary threaded pipe cap.

The pipe framework holds the fuel for this portable motor-generator set. The strange "tank" is filled through the capped corner post extending through the roof at the right.

The filling of this frame container above the roof eliminated the hazard of handling fuel within the shelter. The tubular frame had a fuel capacity of more than three times that of the original tank and was also much less likely to be damaged in transportation.

» «

Brazing Copper Bars

THE incandescent carbon brazing process is called upon to join copper bars for transformers at the Sharon, Pa., plant of the Westinghouse Electric & Mfg. Co. The bars are gripped between the carbon jaws of specially designed brazing tongs and fused together when the operator presses the push-button control under his thumb. The brazing is accomplished without the use of solder, thus aiding in the conservation of war-scarce materials.

Water-cooled brazing tongs which were developed in order to join two copper bars.

The temperature of the carbon blocks may be as high as 1,800 F—close to the melting point of copper—but thanks to the water-cooling system the end of the tongs held in the operator's hand will never become uncomfortably warm. Dark glasses protect the operator's eyes from the vivid orange glow created by the heat of the incandescent carbon.

HOW ABOUT sending us some of your own ideas for "On the Job"? Just a few words and a photograph will do the trick. Payment will be made at our usual rates. Address: Editorial Department, THE WELDING ENGINEER, 506 S. Wabash Ave., Chicago 5.

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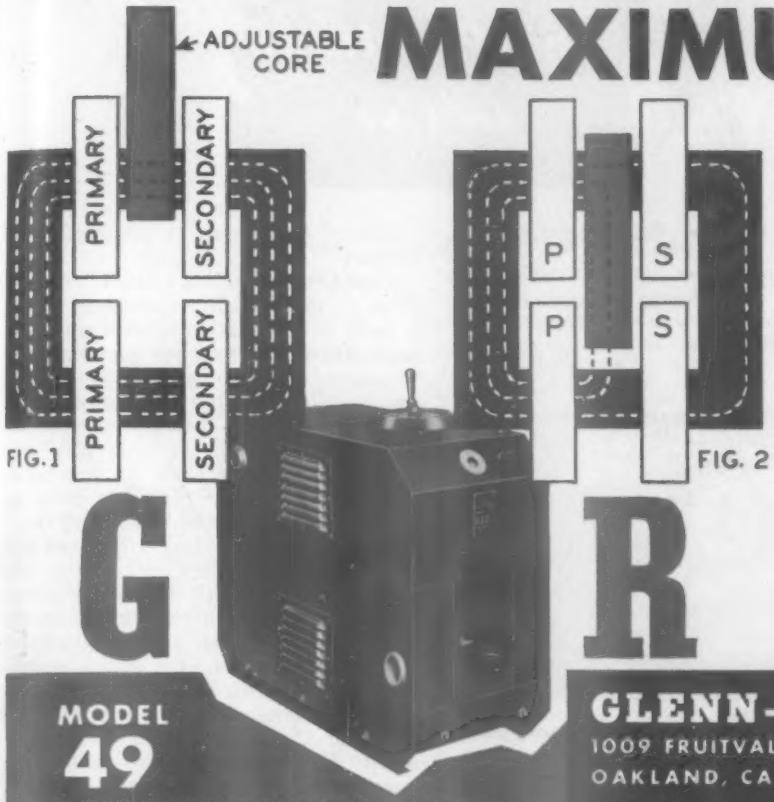

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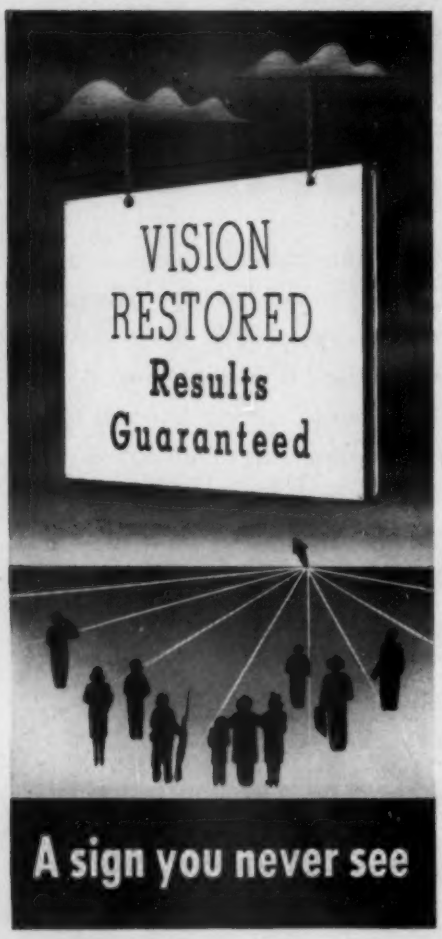

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New Products to Use

Stored Energy Welding Gun

★ A portable gun-type spot welder that uses the stored energy principle and variable pressure cycle is announced by **Sciaky Brothers,** 4915 West 67th St., Chicago 38. This model, **PS2R-1,** was

Sciaky PS2R-1. This portable welding gun permits spot welding operations on large or fixed aluminum structures.

designed for the welding of aluminum and light alloys. With it, tacking operations as well as structural welding can be accomplished on large or fixed aluminum structures. The gun is rated at 100 kw and can weld two aluminum sheets of thicknesses from 0.016 up to 0.064 in. —corrosion-resisting steels from thicknesses of 0.016 to 0.080 in. The unit is of the radial type and can pivot 180 deg, permitting the welding gun to reach an area represented by a half circle 23 ft in diameter. The gun also has a transversal movement of 12 ft in a straight line and a vertical movement of 20 in. above or below a minimum position. The weight of the gun and cables is compensated for by a balancing device, and the gun travels on a monorail over a length of 3 ft 4 in. Pressure up to 1,600 psi is applied by means of an air-operated hydraulic booster.

» «

Stud Welding Gun

★ The **Nelson Electric Arc Stud Welder** was developed some time ago to facilitate the welding of steel studs to ship decks in order to secure wood decking. The new Model "H" weighs less than former models and has only one third the number of parts, thus simplifying maintenance. It does not have to be cocked but will operate as often as the trigger is pulled. A tell-tale light on the side of of the gun indicates when contact is made between stud (or insulation pin) and plate. Another feature is a constant flow of electricity through the stud or insulation pin in order to burn paint off the bulkhead and assure a good electrical contact.

Flux-filled welding studs ranging from ¼ to ½ in. in diameter and from 1 to 8 in. in length are used with this gun. Insulation pins for securing fibre glass, etc. may also be used. When trigger is pulled, the gun will automatically lift the stud to a distance of approximately ⅛ in. from the steel plate and hold it in position while an arc burns between the stud and plate. At the proper instant, the current is shut off by a timer, and the gun plunges the stud into the plate. The molten end of the stud completely fuses with the molten puddle of steel that the arc has formed on the plate so that a dense, solid weld ensues. The entire operation, it is stated, is completed in less than half a second: manufacturer claims that one operator can end-weld about 1,000 studs or approximately 1,500 insulation pins in an eight hour shift. **Nelson Specialty Welding Equipment Co.,** 440 Peralta St., San Leandro, Calif.

Nelson Model "H" electric arc stud welder. It end-welds either studs or large headed insulation pins to steel decks or bulkheads.

» «

A-C Electrodes

★ **"Raco" Type H-D No. 11** A-C shielded-arc electrodes are designed to produce all-position welds of highest quality such as are required in shipbuilding, pipe line construction, boiler work, etc. This type, states manufacturer, meets the requirements of the following specifications: U. S. Navy Specifications 46E3, Grade III, Classes, 1, 2 and 3; American Shipbuilding Specification H1G and B1G; AWS-ASTM Specification A233-42T, Type E-6011; ASME Boiler Code, Paragraph U-68. The Type H-D No. 11 electrode comes in 3/32, ⅛, 5/32, 3/16, 7/32 in. diameters (14 in. lengths only) and in ¼ and 5/16 in. (18 in. lengths only). **The Reid-Avery Co.,** Dundalk, Baltimore, Md.

(Continued on page 77)

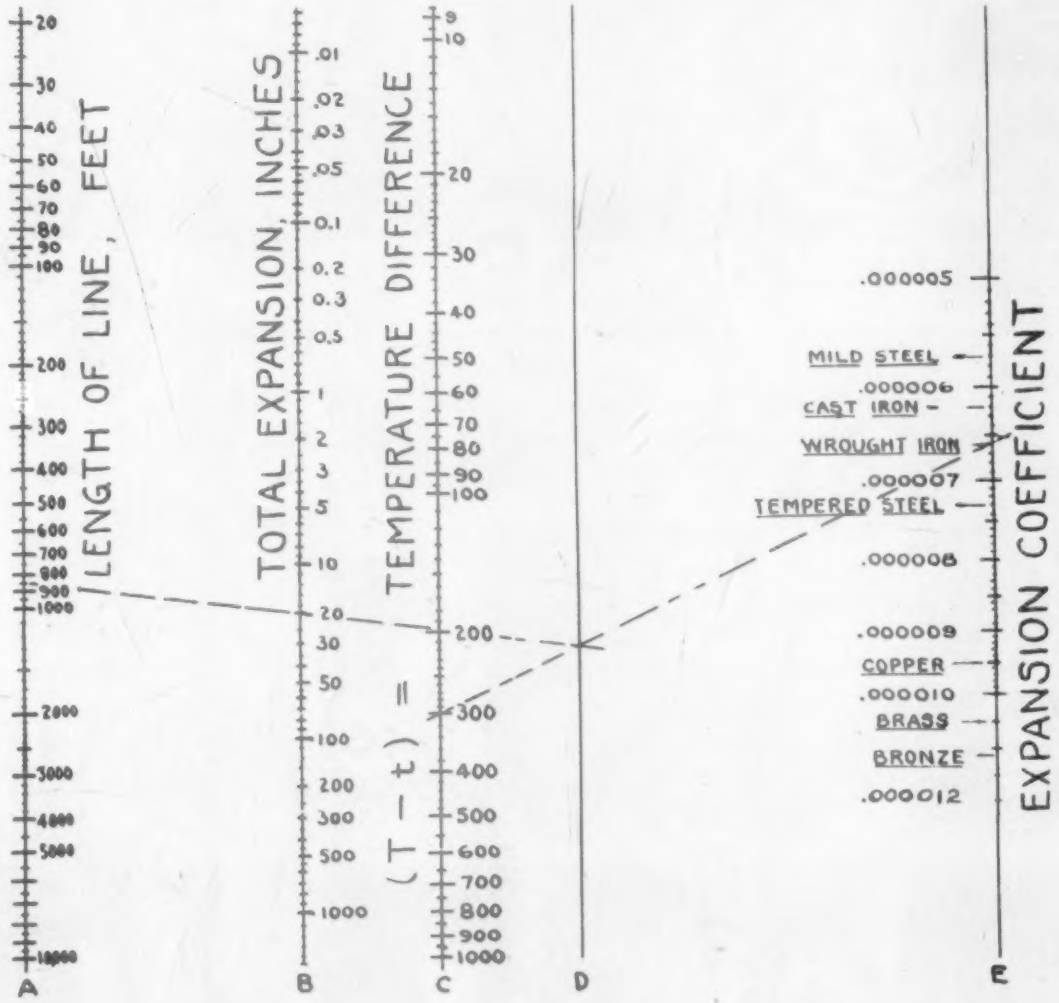
An "All Metal" Expansion Chart

By W. F. SCHAPHORST, M. E.

THE accompanying nomograph chart will be found useful for quickly determining the expansion of any ordinary metals—such as mild steel, wrought iron, copper, brass—or any material having an expansion coefficient between the limits 0.000005 and 0.000012 in. per ft per deg F of temperature change. The chart handles any length from 20 to 10,000 ft.

For example, how much will 850 ft of wrought iron pipe expand when the temperature increase is 300 F? Referring to the chart, the answer is obtained by connecting 300, column C, with the coefficient of expansion of wrought iron, column E, and locating the intersection with column D. Then from the point of intersection project a line to 850, column A, and the expansion is found to be 20 in. in column B.

The temperature difference, column C, is found by subtracting the minimum temperature from the maximum. Thus a steam pipe at its coldest may be 40 F. At its hottest it may be 740 F. The difference is therefore 740—40 or 700 F.



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RACO 11 ELECTRODES!

Yes, we mean it! You can now count on immediate delivery of RACO 11

...the electrode that the Welding Foreman of one of the largest shipyards calls "the best his crew has worked with... an electrode that assures the user X-Ray clean welds free from gas pockets and slag inclusion."

...the electrode that has proved to be the ideal utility electrode... that can be used on AC or DC... and give superior results on mild steel in all positions.

...the electrode that complies with the following specifications:

A.W.S.—A.S.T.M. Filler Metal Specifications A233-42T Classification E6011; Navy Bureau of Ships Specification 46E3, Grade III, Classes 1, 2, 3; American Bureau of Shipping Specifications HIG and BIG; A.S.M.E. Boiler Code, Paragraph U68.

All those features... plus immediate delivery! Write NOW for samples of RACO 11 ... and full information on RACO electrodes for every welding job.

The REID-AVERY COMPANY

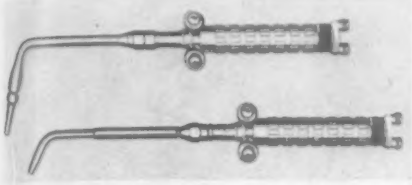
DUNDALK BALTIMORE 22 MARYLAND

New Products

(Continued from page 74)

Aircraft Welding Torches

★ **Torchweld Models 40NL and 41NL** are lightweight welding torches designed for satisfactory welds on such critical materials as aircraft tubing, light sheet metal, aluminum and various alloys. They may be used extensively in the aircraft and sheet metal industries and other places where fast, light torches are needed for welding materials up to ¼ in. thickness.



Torchweld 40NL and 41NL torches.

Model 40NL uses a style No. 170 tip, a No. 39 tip head and a No. 11897 mixer. Model 41NL employs a No. 12901 mixer and a style No. 70 welding tip. Interchangeable mixers permit the use of either style tip on either torch. **National Cylinder Gas Co.**, 205 West Wacker Drive, Chicago 6.

» «

Series S timer. This new line consists of eight models, with calibrations ranging from 1 second to 5 minute intervals. Maximum periods range from 1 minute to 3 hours.

Signalling Timers

★ The eight timers in the newly announced **Series S** are designed to command visual and audible attention. A socket on each timer case also provides for the automatic closing or opening of a circuit.

In operation, the pointer is set manually to the required interval; this action closes a circuit which operates a pilot light. The pointer revolves counterclockwise toward zero while, at any second, the exact time elapsed is shown on the dial. When the interval has been completed, a buzzer sounds and the pilot light goes out. Rapid resetting for the same time interval is provided by an adjustable back stop. **Industrial Timer Corp.**, 117 Edison Place, Newark, N. J.

These belts are coated with abrasives especially designed for swing-frame grinding operations. A belt 4 by 136 in. (an average size) offers 544 square inches of cutting surface.

Metalite Grinder Belts

★ These new heavy-duty grinding belts are designed for abrasive belt grinders of the swing-frame type. They are said to offer many advantages including stepped-up production and cooler cuts. "Uniflow" joints assure a smooth-running operation. A folder describing this grinding process may be obtained from **Behr-Manning Corp.**, (Div. of Norton Co.), Troy, N. Y.

GOOD SAFETY RECORDS REQUIRE IMPROVED LEATHER!

THE LEATHER in protective garments and accessories you buy for welders is described to you as "chrome tanned." What does that mean to you?

CHROME TANNED means the use of chromium salts instead of vegetable and bark tannic acids. The chrome process is used by most tanners. It is merely a method, just the same as broiling meat is a method of cooking.

YOU KNOW how much depends on the cut of the meat and the skill of the cook!

NOT EVERY TANNER gets the same hide selections, nor puts them through the same operations . . . yet most use chrome as a tanning agent.

THROUGHOUT 3 GENERATIONS craftsmanship has been a first principle at the Lichtman tannery. Intensive, scientific research developed many improvements in the technique of leather making and good results require the best available raw stock.

TODAY, Lichtman leather for welders' garments is the preferred protection from the effects of sparks, fire, light rays, and heat.

LICHTMAN J.L.&S. LEATHERS TRADE MARK

At present, we are doing our best to supply our customers—the leading manufacturers of protective clothing and equipment — with all the LICHTMAN leather they want.

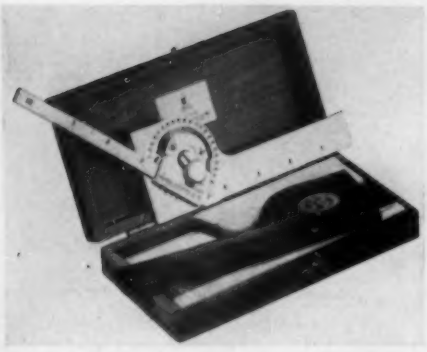
When you CAN choose . . . just make comparisons.

You definitely will prefer LICHTMAN'S, and no longer be content merely with any chrome tannage.

J. LICHTMAN & SONS

Tanners of Quality Leathers Since 1883

NEWARK 5, N. J.



"Xactor." A locking protractor equipped with a Vernier turret for precision angle measurements.

Lock-Type Protractor

★ "Xactor," a new pocket-size locking protractor, has many uses, including the sketching and laying out of tools and machine parts, dies, jigs, etc. It can also be used for accurate measurement of the angles of drill points, tool bits, machine ways, depths of deep holes, etc. and for inspection of finished parts. The instrument has a Vernier turret and a sliding scale pivoting the full 360 deg; both scale and turret may be locked to secure any specific measurement or angle. This feature facilitates mass gauging in cases where many items of the same size or angle must be checked. **Industrial Engineering Co., Inc.**, 141 West Jackson Blvd., Chicago 4.

Seam Spot Welder

★ A heavy duty resistance welder which can be converted for either seam or spot welding operations is announced by the **Eisler Engineering Co.**, 740-770 South 13th St., Newark 3, N. J. In the accompanying illustration, the large picture and lower insert show circular and longitudinal seam welding respectively while the upper insert shows the spot welding application. Conversion from seam welding to spot welding is accomplished by removing the caps from the upper and lower turrets and replacing the seam wheel shafts with spot welding horns. The adjustment from one to the other seam welding position is performed by loosening four nuts on both upper and lower turret holders, rotating the turrets and fixing them in the desired position; this is facilitated by a matching notch which marks the correct alignments.

Universal resistance welder. It may be converted from a spot welder (upper insert) to a longitudinal seam welder (lower insert) or to a circular seam welder (large picture).

In either seam or spot welding, the upper electrode is attached to a large square ram and is actuated by a double-acting air cylinder. The electrode pressure is adjusted by an air pressure regulating valve. The welding transformer is available in 100, 150 and 200 kva (and larger sizes), 220 or 440 volts, 60 cycles.

» «

Drawing Board Tops

★ **"No-Ink"** drawing board tops are made of a resilient composition, ⅛ in. thick, that is permanently glued to any wooden drawing board. With a 3-H pencil and this composition surface, states manufacturer, a solid-line drawing may be produced which will make clear, legible blue prints and van dykes. Instead of ink, a double pencil stroke is used for each line. Another advantage of this drawing board surface is that it permits the use of drafting tape, thus eliminating thumb tack holes in the board. **W. H. Long Co.**, 425 N. Clark St., Chicago.

» «

Skin Protector

★ **CSC Protector** is a non-sticky, white and greaseless product to eliminate permanent griming and grease-staining of hands and nails. **Commercial Solvents Corp.**, 17 East 42nd St., New York City 17.

FOR SMOOTHER WELD GRINDING —3 to 6 TIMES FASTER!

JONES Abrasive Belt SWING GRINDER

You get high-speed weld grinding and smooth, even surfaces with the easy-to-use Jones Abrasive Belt Swing Grinder. This portable unit combines the controlled stock removal feature of a snagging wheel with the smooth surface grinding features of disc grinders.

Speed up your tank grinding 3 to 6 times with the easily portable Jones Swing Grinder, using quick-change, fast-cutting abrasive belts. Readily mounted for covering large areas—simple controls handy to operator—uninterrupted high-speed grinding.

The Ideal Unit for Automatic Weld Grinding—Automatic welding is 2 to 3 times faster than manual operation—why not step up your production line another 2 to 3 times using the Jones Swing Grinder to remove that surplus weld!

CHECK THESE JONES FEATURES

- High Speed Cutting
- Smooth, Even Surface
- Uninterrupted Grinding
- Easy to Install and Operate
- Quick Abrasive Belt Change
- Perfect Balance at Any Angle
- Reduces Time and Cost

WRITE TODAY— A four-page bulletin "The Jones Abrasive Belt Swing Grinder" gives full details on this time saving, cost-cutting unit. Write for your copy today.

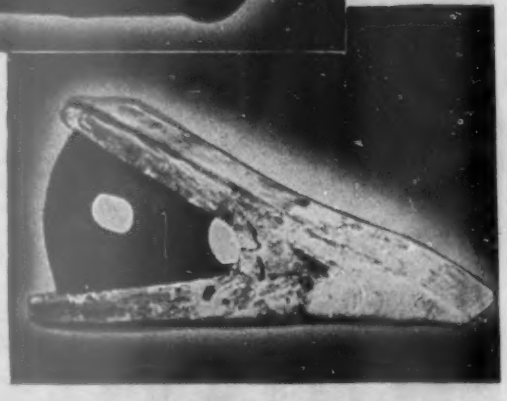
JONES ENGINEERING COMPANY
DEPT. C-1 · ELLWOOD CITY, PA.
Manufacturers of Abrasive Belt Grinding Equipment

WHAT STEEL COMPANY MADE THE *First* MANGANESE-NICKEL WELDING ROD?

■ Timang Welding Rod is one of the important outgrowths of the discovery of the air-hardening properties of manganese-nickel steel. Timang made possible, for the first time, a weld in manganese steel as strong as the original part and without reheating and quenching.

It was logical that this should be a Taylor-Wharton development. Taylor-Wharton introduced Hadfields Manganese Steel to America in 1892 and has since led the advance in its use and refinement. TISCO Manganese Steel is known the world over for its unusual resistance to heavy shock and abrasion, and for its remarkable property of work hardening. It is used in the wearing parts of various equipment including paper making, mining, quarrying, dredging and for railway trackwork.

Above: Mantle of gyratory crusher, rebuilt with Timang, equals original service record.



Right: Steam Shovel point repaired with Timang, works like new.

This 2½ yd. front, having two bad cracks, 21" long, thru the bolt holes, was quickly repaired with Timang, saving the cost of a new front.

"TIMANG" (a registered trademark) is protected by U. S. Patents Nos. 1,732,202, 1,907,385, 2,026,467, 2,026,468; Canadian Patents Nos. 302,154 and 335,295; and by patents in countries overseas.

Est. TW 1742

Taylor-Wharton Iron and Steel Co.

HIGH BRIDGE, NEW JERSEY • EASTON, PENNSYLVANIA

News of the Industry

Aluminum Now Easier; WPB Permits New Uses

The position of aluminum has become sufficiently comfortable to permit its use in additional types of war and some essential industrial production, the War Production Board explained in issuing its Supplementary Order M-1-i as amended. For certain purposes, aluminum may now be used as a substitute for copper, thus relieving the strain on supplies of the latter.

Some of the new uses which are permitted under the amended order include: data and instruction plates not exceeding 0.035 in. in thickness, electric bus bars, bare electrical conductors and current-carrying accessories for conductors, cooling fans for electric motors, structural parts where lightness is an element to be taken into consideration, coils and fins for refrigeration and heating equipment, certain types of safety equipment and X-ray equipment.

The order also permits aluminum ingots to be added to galvanizing baths and permits the manufacture of aluminum bottom boards for use in foundries and aluminum jigs and fixtures for use in the production of aircraft.

Important new reserves of bauxite have been discovered in Alabama by the Bureau of Mines and the Geological Survey, and five mining companies have already shipped out 40,300 tons of aluminum ore. Additional reserves, it is stated, are being discovered nearly four times as fast as the bauxite is being mined.

» «

Chicago Technical Groups Unite for Joint Activities

Twenty-six technical associations in Chicago have banded themselves together to form the Chicago Technical Societies Council. This new organization will perform a service that is beyond the scope of any individual group; namely, provide a common instrumentality for all groups interested in the broad and inclusive phases of modern engineering, technical and scientific studies. Its immediate objectives are given as follows:

To organize another War Production Clinic in the spring of next year to cover subjects not included in the last conference.

To coöperate in solving postwar employment problems.

To publish a directory of speakers on technical and general interest subjects, together with information on available entertainment, slides, motion picture films and projector equipment.

To publish a calendar of scheduled meetings of the affiliated societies so that programs which might be of interest to nonmembers of a particular society will be made known to them.

To attempt to avoid duplication of lecture subjects and conflicting dates of meetings.

To arrange at least one large scale intersociety meeting a year with a speaker of national prominence.

To hold one or more conferences of the member societies whenever it is deemed desirable to do so.

To compile a directory of meeting and refectory facilities in Chicago that are suitable for technical gatherings.

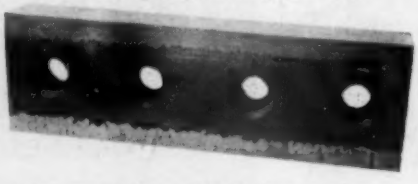
To compile and publish a "Who's Who" of the engineering, technical and scientific men residing in the Chicago area. This projected directory will list each individual member of the 26 affiliated societies and will give detailed information regarding him. There will be cross-indexing by societies, by technological classifications and by firm names.

Thomas S. McEwan, American Society of Mechanical Engineers, is chairman of the Chicago Technical Societies Council; B. E. Schaar, American Chemical Society, is vice-chairman, and K. H. Hobbie, American Society for Metals, is corresponding secretary. The American Welding Society is represented by L. S. McPhee of the Whiting Corp. and T. B. Jefferson, editor of THE WELDING ENGINEER. T. B. Jefferson is also chairman of the Program and Bulletin Committee.

Still going strong after two weeks

Where Uncoated Blades Quit in Five Days...

HOT SHEAR BLADES, *(above) prior to hard-facing with Coast Metals, and (below) after hard-facing and rough grinding.*



YES,—these hot shear knives have what it takes to shear 6⅜" x 3¾" stainless steel containing 15% manganese. Protected with a Coast Metals Hard-Facing that is particularly resistant to heat and abrasion, they stayed continually on the job for 15 days straight, shearing 1,800 tons every 24 hours. And were still going strong,—when a change in production schedule became necessary. Here uncoated blades lasted only 5 days.

Another mill reports, after coating its knives with Coast Metals alloy, that it is now shearing 69,000 tons of armor plate steel, whereas 13,000 tons formerly had been the limit. In still a third plant, blades faced with Coast Metals are outwearing and outlasting blades faced with other materials 4 to 1. And so it goes!

COAST METALS HARD-FACING is today's answer to making your equipment, both old and new, last longer. Easily welded by the electric arc or gas torch to all ferrous metals.

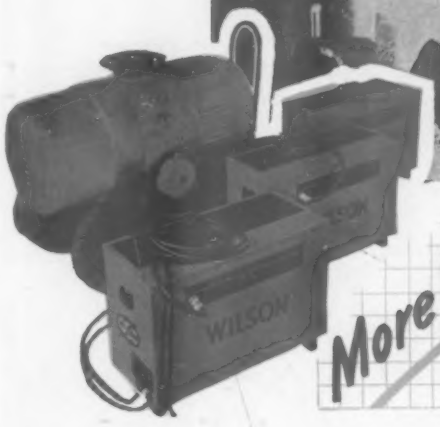
Write for "Your Equipment's Best Protection Against Wear"

COAST METALS, INC.

Plant and General Offices: Canton, Ohio
Executive Offices: New York, N.Y.

COAST METALS *hard-facing weld rods*

MAKE YOUR EQUIPMENT LAST LONGER



More Welding-Better Quality Welds with the WILSON "HONEY BEE" ARC CONTROL STATION

Connecting a number of Wilson "Honey Bee" stations to any constant potential generator, gives two timely advantages:

1. By providing more arcs per generator, it permits an increase in the number of welding operations performed simultaneously from a single generator.

2. It assures better quality welds – especially on light-gauge metal – through the "Honey Bee's" Remote Arc and Crater Control.

Each operator using a "Honey Bee" station holds a remote arc control switch by which he may regulate his current (from zero to maximum) while welding – *without first extinguishing the arc.* Only the Wilson "Honey Bee" provides this valuable advantage. In addition, the "Honey Bee's" Remote Crater Control permits the operator to fade out the arc slowly – never abruptly – to prevent crater cracks, porosity and similar weld defects.

The Wilson "Honey Bee" is available in 75 amp. and 150 amp. sizes. For further details get in touch with your nearest Air Reduction office. A descriptive bulletin ADW-47 will be forwarded on request.

Metal deposited with standard welding machine and no crater control.

Metal deposited with Wilson "Hornet" equipped with "Honey Bee" Remote Arc and Crater Control Station.

Photo courtesy of Curtiss-Wright Corporation.

WILSON

WILSON WELDER and METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.

Ransome Machinery Co., Dunellen, N. J. was recently awarded the Army-Navy "E" pennant for "outstanding war production." Left to right are: Leonard D'Amelio, veteran employee of Ransome; Lieutenant (J.G.) William Murphy of the U. S. Navy; Vice-President L. R. Wilson of Ransome and Lieutenant Colonel Austin D. Smith, Corps of Engineers, U. S. Army. Welding positioners built at the Dunellen plant are used in Navy shipyards and repair bases and also help to build Liberty ships.

IT'S *Quicker* TO USE A

CMD *Triple-Duty*
CHIPPING
HAMMER

Triple Duty
TYPE CB
3 tools in one. Brush replaceable when worn. Well balanced. Weight 1 lb.

With the Type CB combination drift and chisel hammer, a welder can greatly speed up his output. For he can spend more time welding and less time removing slag—less time laying down tools and picking them up. Without even setting aside the electrode, he can start immediately to chip away the slag. The handy replaceable brush on the handle of this hammer is instantly available when he needs it. For details and prices on this and other popular CMD welders' Chipping Hammers, ask your jobber for latest circular or write direct.

CHICAGO MANUFACTURING AND DISTRIBUTING COMPANY
1928 WEST 46th ST., DEPT. W., CHICAGO 9, ILLINOIS

One-Ship-a-Day Record Set at Richmond Yard

A new world's record in ship production, a total of thirty-one 10,500 ton Liberty ships during the thirty-one days of October, has been set by the Richmond, Calif., Shipyard of the Permanente Metals Corp. This one-a-day record was achieved with the launching of the *S. S. James King*, bringing Permanente Metals vessels launched to 356, of which 348 have been delivered for active service.

October's 31 vessels were produced with a total of 31,000 men and 11,000 women. In comparison, the January production of 17 vessels was accomplished with 36,000 men and 5,000 women. Thus only a thousand new employees were added, although ship production has been almost doubled.

The delivery of 348 ships, Permanente Metals officials point out, represents a merchant fleet of 3,654,000 tons or what would be a sizable portion of this nation's total prewar tonnage. This total is said to represent 69 more vessels than any other shipyard has so far delivered during war days.

» «

Makes Quick Conversion to Artillery Carriages

Conversion in less than a week from the production of tanks to heavy artillery carriages was recently effected at one of the Pullman-Standard Car Mfg. Co. plants at Hammond, Ind. One of the tank shops had to be cleared of practically all machinery formerly used and new installations were needed in order to change from the manufacture of M-4 tanks to the production of carriages, limbers and bogies for 155 mm guns. Nevertheless, fewer than seven days were necessary between the time the last tanks were shipped from the plant and the time work started on the new contracts.

» «

WPB Says No Holidays Except Xmas Week-End

War workers will have to stick at their jobs on what were, in happier times, considered holidays, Chairman Donald M. Nelson of the War Production Board decreed last month. Full work schedules should be observed in all war plants with the single exception of the Christmas week-end, ordered Chairman Nelson. Even on that occasion, it is requested that work be carried on in blast furnaces, open hearth furnaces and plate mills.

» «

New Movie Shows Thermit Welding of Stern Frames

A new technicolor sound movie, "Fabrication of Stern Frames by Thermit Welding," has been produced by Metal and Thermit Corp. in coöperation with the North Carolina Shipbuilding Co. and the St. Johns River Shipbuilding Co. This film shows how stern-frame castings weighing around 30 tons or more can be turned out at the foundry in two, three or four piece sections and assembled by thermit welding in the shipyard.

MOORE DRY DOCK CO. HELPS SPEED PRODUCTION *with this* FLEXIBLE WELDING CABLE

Photos courtesy Moore Dry Dock Co.

With 1600 women weldors helping to speed freighter production, Moore Dry Dock Company finds highly flexible welding cable more than ever a necessity. At Moore, Belden Welding Cable is used by both men and women weldors.

Belden cable has the flexibility that increases cable life, makes handling easier, and reduces weldors' fatigue. Its tough, durable insulation stands up in long service over hot metal plates—its long life means less time out for replacements. Investigate Belden Welding Cable today.

Awarded the U. S. Treasury Special Citation of Merit for initiating the War Bond-or-Cash Dividend Plan

Belden WIRE

BELDEN MANUFACTURING COMPANY . . . 4677-A W. Van Buren St., Chicago 44, Ill.

Officers Selected for WPB's Welding & Electroplating Branch

William M. Haile, chief of the Welding and Electroplating Equipment Branch of the General Industrial Equipment Div. of the War Production Board, states that the appointment of heads for the various sections and units is now as follows:

William M. Haile, chief; R. A. Merritt, deputy chief; P. M. Hall, chief of the Resistance Welding Section; W. W. McCord, chief of the Electroplating & Anodizing Section; C. A. Rice, chief of the Electroplating Unit; R. L. W. Hawkins chief of the Arc Welding Section; R. A. Merritt, chief of the Gas Welding & Cutting Section; H. R. Smith, analyst.

Mr. Haile was formerly deputy chief and chief of the Gas Welding & Cutting Section. Owen L. Howland, the former chief of the Welding and Electroplating Branch, is now with Metal & Thermit Corp.

» «

Whiting Offers Engineering Service on Welding Positioners

The Quickwork Div. of the Whiting Corp., Harvey, Ill., has announced a complete engineering service for its customers covering the design and construction of special welding positioners. The company manufactures a line of positioners ranging from small hand-operated units to machines with capacities of over 20 tons.

WPB Clarifies Order L-318 on Spot Welding Electrodes

An interpretation of General Conservation Order L-318 was issued by the War Production Board on Nov. 10 in an effort to clarify the provisions applying to the manufacturers of spot welding electrodes. Under this interpretation, all persons who manufacture such equipment are included under the provisions of the order, regardless of whether they manufacture the electrodes for resale or strictly for their own use.

Order L-318 (see page 90, THE WELDING ENGINEER, November, 1943) restricts the use of certain critical materials in the manufacture of spot welding electrodes.

» «

G-E Engineers Save 850,000 Lb of Tin

More than 850,000 lb of tin have been saved by the General Electric Co. in the 23 months since Pearl Harbor as a result of changes adopted in solders and babbitt alloys. Calculated in terms of No. 2 food cans, this saving corresponds to about 825,000,000 cans—enough to fill many a pantry.

In place of former tin-rich solders, General Electric is today using a general-purpose solder containing 20% tin, 1.25% silver, 1.5% antimony and the balance lead. A silver solder containing 2.5% silver and the balance lead is used for applications requiring high rupture strength.

Babbitt alloy, formerly containing 83⅓% tin and 8⅓% each of copper and antimony, today contains but 1% tin. The remainder of the babbitt now being used by General Electric consists of 15% antimony, 1% arsenic, 0.5% copper and 82.5% lead. This lead-base babbitt is now generally used for all babbitted bearings except those on large turbine generator sets, on guide and thrust bearings for vertical water-wheel generators and for war implements on which high-tin babbitts have been specified.

» «

Victory Scrap Drive Continued Indefinitely

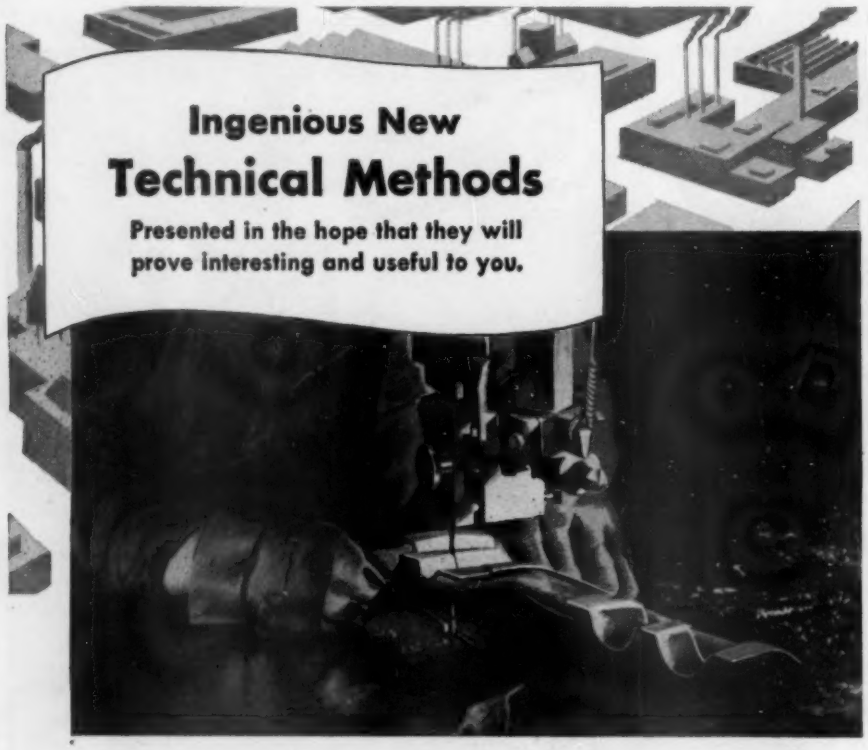
The "Victory Scrap Bank" Drive, scheduled to terminate on Nov. 15, has been continued indefinitely, announcement was made last month by H. M. Faust, director of the Salvage Div. of the War Production Board. "Mills are now consuming more purchased scrap than they are receiving," said Mr. Faust. "Stockpiles are shrinking . . . the winter months lie just ahead and our inventory position is not improving."

In addition to the increasing amount of iron and steel scrap needed to maintain production requirements, the recent coal strike caused an increase in the amount of scrap used in steel furnaces.

» «

Magnesium Processing Film Produced by Dow Chemical Co.

A technical film showing processing methods for magnesium alloys has been recently prepared and released by The Dow Chemical Co., Midland, Mich. This film deals with the welding, machining, forming, riveting and surface treating of magnesium.



Ingenious New

Technical Methods

Presented in the hope that they will prove interesting and useful to you.

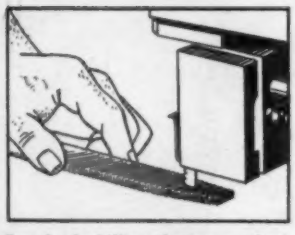
Hard Steels Cut by Heat Generated by Super High Saw Speeds

Ordinary band-saws, when operated at unbelievable high speeds up to 12,000 feet per minute, cut through hard steels and alloys by heat generated from the friction of the saw against the metal to be cut. The cutting effect is more that of burning through the metal than actual cutting. The heat generated is sufficient to melt or burn out the metal in the saw cut but not enough to draw the temper on the sides.

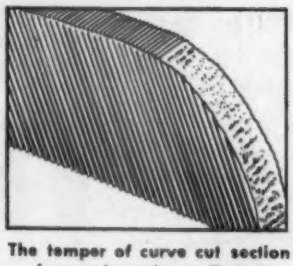
The hardness of either saw or metal to be cut is of little importance. Thin metal sheets are cut like paper, and plates up to one inch in thickness can be cut at speeds of ten inches per minute.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for Victory.

You can get complete information about this method from Bell Aircraft Corporation, Buffalo, New York.



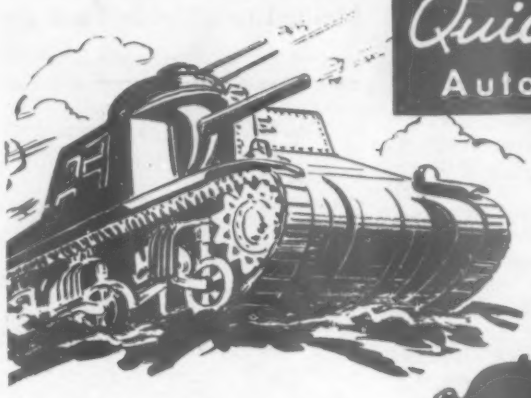
Proof of ability of new method to cut hard materials is demonstrated by operator cutting a file.

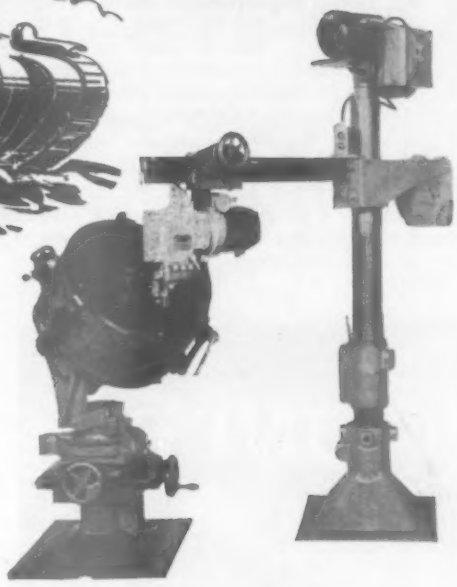


The temper of curve cut section shown above is unaffected.

X-60

Quicker Welding . . With This Automatic Welding Machine Fixture





THIS Acme dual fixture arrangement permits practically constant use of an automatic welding head, because one of the fixtures can be reloaded while the other is engaged in the welding operation.

The holding machine can be set to revolve at any angle from vertical to horizontal. (Illustration shows a wheel being welded at 45° angle.) Positioner arm swings from one fixture to the other, locking in proper position. Speed of rotating the work is adjustable, as desired.

Reloading Is done During Welding Operation

ACME *Manufacturing Co.*
1642 HOWARD ST. • DETROIT, MICH.

WRITE
for information. Whatever your positioning problem on automatic welding, let us help you solve it. Write for complete information.

Gasweld **G-W PORTABLE**
FLAME CUTTING MACHINE

• The "Gasweld" G-W Flame Cutting Machine is a portable, motor driven torch for cutting billets and straight lines, strips, circles, arcs or simple irregular outlines in steel plates. Either straight or beveled edge cuts are easily made.

Cuts can be made clean and accurate, eliminating in many cases, the need for further machining. Light, compact—weighing only 45 pounds—the machine is easily moved from place to place in the shop. Speed range—four to sixty inches per minute; travels either forward or in reverse direction.

The G-W Portable Flame Cutting Machine effectively lowers cutting costs and speeds production over hand-cutting methods.

Write for illustrated bulletin and price to

Buffalo, N. Y.
Cincinnati, O.
Chicago, Ill.
Detroit, Mich.
Louisville, Ky.
Milwaukee, Wis.

WALL CHEMICALS DIVISION of
The Liquid Carbonic Corporation
3110 S. Kedzie Ave., Chicago, Ill.

Rochester, N. Y.
Toledo, Ohio
Canada:
Montreal, Quebec
Toronto, Ontario
Windsor, Ontario

Westinghouse Plans Quick Conversion to Peacetime

Westinghouse Electric and Mfg. Co. has complete plans in readiness for reconversion to civilian production as soon as war production demands slacken, it was disclosed at the company's annual conclave of officers and managers. Reports from the men who manage Westinghouse's 25 principal manufacturing divisions and district operations included these significant forecasts:

1. The period of readjustment to peacetime conditions should be no more difficult than the adjustment to wartime conditions.

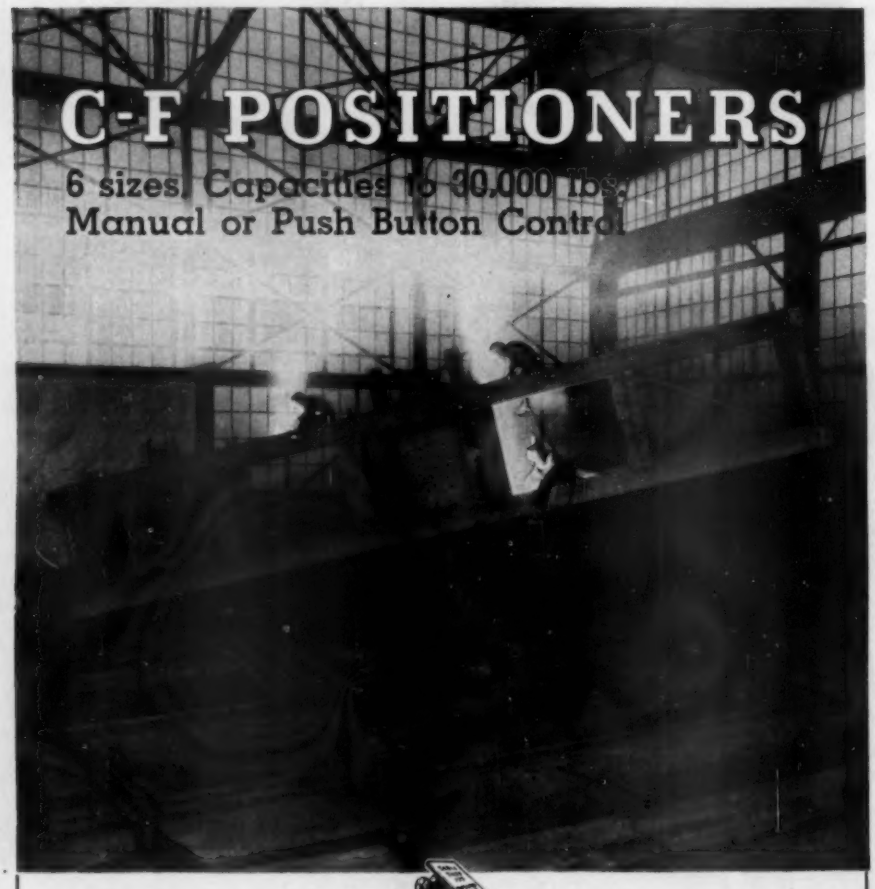
2. The pent-up demands for the goods of peace will be unprecedented, owing to the fact that these goods in both homes and factories are wearing out.

3. Unprecedented means of purchasing—cash, bonds and credit—will exist after the war.

» «

Hagerty Equipment Named Allis-Chalmers Distributor

The Paul J. Hagerty Equipment Co., Peoria, Ill., has been made a distributor for Allis-Chalmers and will handle Ampac welders, "Weld-O-Tron" and other Allis-Chalmers welding equipment throughout the Central Illinois territory. Members of the Hagerty organization are: Paul J. Hagerty, president; Pat Vaugn, Bill McClintick, Ed Woltzen, Herb Hale and Jim Kock.



The extra strength built into C-F Positioners enables them to withstand the extreme side thrusts and torsional strains met in positioning cumbersome or unbalanced loads—Coupled with the C-F *pedestal mounting* and adjustable height features, this extra strength increases the range of work handled, makes each C-F Positioner the most versatile tool in its capacity. *You can do more work with C-F Positioners.*

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO., 1309 S. Kilbourn Ave., Chicago 23, U. S A.

Production of 7 Alloy Steels Limited to Electric Furnaces

In order to release open hearth capacity for carbon steel production, the War Production Board notified steel producers in its Direction 2 to Supplementary Order M-21-a that hereafter seven specified types of alloy steel are to be produced only in electric furnaces, except where unusual circumstances permit exception. These types of steel are described as follows:

1. All airborne aircraft steel where aircraft quality is specified.
2. All airborne aircraft tubing.
3. All armor piercing shot body and cap steel, 20 mm and larger.
4. All steel for integral parts of small arm rifles and machine guns, up to and including 60 caliber, excluding mounts and tripods.
5. All steel for integral parts of guns, cannons, rifles and howitzers, 20 mm and larger, excluding mounts and carriages.
6. All bearing steel, including carburizing grades.
7. All gear steel excluding gears made from plate.

» «

OPA Sets Ceiling on Alloying Agents

A specific OPA regulation—Maximum Price Regulation No. 489 (Tungsten, Molybdenum, Vanadium, Cobalt and Certain Other Alloys and Metals)—provides dollars-and-cents ceilings for a group of important alloying metals used in the production of steel. This regulation, which became effective on Nov. 8, supplants the General Maximum Price Regulation, under which ceilings were the highest prices that individual sellers had charged during March, 1942. However, with minor exceptions, the ceiling prices provided by the new regulation are the same.

Ceilings for some of the more important of the alloys are:

Tungsten: Ferrotungsten, $1.90 per lb of contained tungsten in quantities of 10,000 lb and more.

Molybdenum: Ferromolybdenum, 95c per lb of contained molybdenum; molybdic oxide and calcium molybdate, 80c per lb of contained molybdenum.

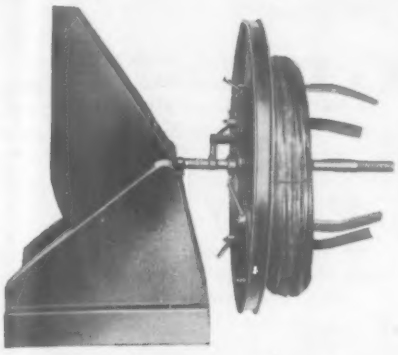
Vanadium: Ferrovanadium, open hearth, $2.70, crucible, $2.80, primos, $2.90, per lb of contained vanadium.

Cobalt: Cobalt metal for metallurgical use, $1.50 per lb in kegs of 500 to 550 lb.

» «

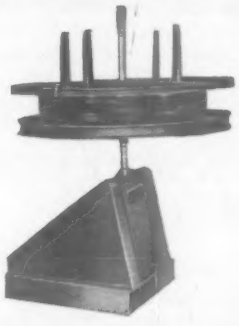
Whiting Employees Receive White Star

Employees of the Whiting Corp., Harvey, Ill., who won the Army-Navy "E" flag last March for meritorious service on the production front, received tidings on Armistice Day of a second honor. This was a renewal of the Army-Navy Production Award, adding a white star to their "E" flag. "You have continued to maintain the high standard that you set for yourselves and which won you distinction more than six months ago," wrote Under Secretary of War Patterson in a letter addressed "To the Whiting Men and Women."



Above — "Shiftweight" Loading Position

Below — "Shiftweight" Feeding Position



A Husky Helper . . . Always "On Its Feet"

• The Moslo "Shiftweight" wire reel eliminates the need for an extra man in handling coils of wire. It is counter-balanced with an automatically shifting weight that holds it steady in either loading or feeding position. Easy to load without lifting . . . Swings easily to feeding position . . . Feeds smoothly and kink-free. A back saver, time saver and money saver.

Write for booklet describing this and other types of wire reels. Upright or horizontal drum reels . . . Upright cone reels, all built to give service, speed production.

Moslo Makes Everything for the Welding Electrode Processing Plant

MOSLO MACHINERY COMPANY

2441 PROSPECT AVENUE • CLEVELAND, OHIO

SIMPLE EVALUATION!

❶ **Purer, hotter acetylene gas at savings *up to 75%*.** ❷ ***All* the gas you want *when* you want it. No delivery delays from bottlers.** ❸ **No large-job interruptions, thanks to Sight Feed's *visible* carbide supply.**

As basic as a-b-c is this testimony of enthusiastic Sight Feed users in every part of America. Pertinent facts, *simple evaluation*, respectfully submitted for YOUR consideration.

THE *Sight Feed* GENERATOR COMPANY • SALES: RICHMOND, IND.; FACTORY: W. ALEXANDRIA, O.

ABOUT PEOPLE

Sergeant Frank C. Cali, who used to assemble gas regulators before the war in the Chicago plant of The Bastian-Blessing Co., has received the Silver Star for "his courage and devotion to duty during an extremely difficult and hazardous operation, which upheld the highest tradition of military service." The citation further stated: "When his company crossed a river ford in Tunisia under direct machine gun, mortar and anti-tank fire, Frank Cali, Technician Fourth Grade, remained behind to assist his comrades in the recovery of mired vehicles. He was instrumental in evacuating two seriously wounded men and in recovering several vehicles."

Sergeant Cali's tank battalion has since participated in the invasion of Sicily.

» «

John B. Ross, formerly with The Linde Air Products Co., has joined Handy & Harman as brazing engineer for the West Coast engineering office. He will make his headquarters at Los Angeles and serve industries and shipyards throughout California, Washington and Oregon.

» «

Ralph M. Johnson has been appointed general sales manager of grinding wheels and abrasive grain for the Norton Co., Worcester, Mass. He had been western sales manager for Norton since 1939.

» «

William R. Moore, formerly sales manager of the Abrasive Div. of the Norton Co., has been made a vice-president of this company and given new sales responsibilities.

» «

Five new trustees recently elected to the board of the Illinois Institute of Technology are: **David T. Siegel**, president, Ohmite Mfg. Co.; **Whipple Jacobs**, president, the Belden Mfg. Co.; **Claude A. Knuepfer**, president and general manager, General Engineering Works; **T. Albert Potter**, president, Elgin National Watch Co.; **Harold B. Smith**, president, Illinois Tool Works.

» «

L. F. McGlincy has been appointed assistant manager of operations, Pittsburgh district of American Steel & Wire Co., a subsidiary of U.S. Steel Corp. **Loren J. Westhaver**, formerly assistant general superintendent, has been named general superintendent of the Donora (Pa.) Steel & Wire Works in order to succeed Mr. McGlincy.

» «

E. A. Murray has been appointed assistant manager of the manufacturers' sales department in the Chicago sales office of American Steel & Wire Co. He was formerly supervisor of the priorities division of the Cleveland general sales office.

» «

Joseph B. Terbell has been promoted from vice-president to first vice-president of the American Manganese Steel Div. of the American Brake Shoe Co. He has been connected with Amsco for fifteen years, serving as salesman, eastern sales manager and vice-president.

» «

Dr. Augustus B. Kinzel, of Union Carbide and Carbon Co., and **Thomas H. Wickenden**, manager of development and research div., International Nickel Co., Inc., are members of a new Technical Advisory Committee created by the New York Ordnance District, Army Service Forces. Other members of the committee are: **Gregory Jamieson Comstock**, professor of powder metallurgy, Stevens Institute of Technology; **Dr. Ralph L. Evans**, Ralph L. Evans Associates, and **Howard A. Poillon**, president, Research Corp.

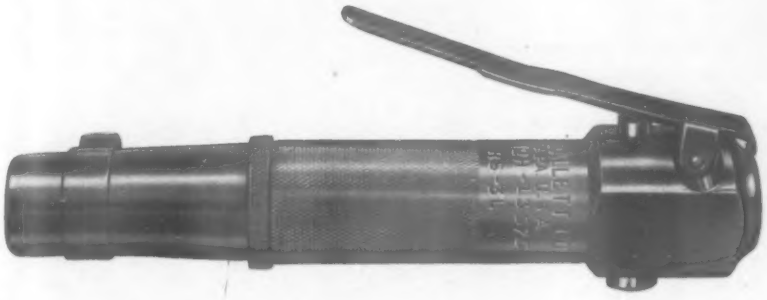
» «

Dr. Nathaniel Baum has been appointed head of a new organic research laboratory established by Turco Products, Inc., Los Angeles.

HERE'S HOW TO KEEP
HUMPTY DUMPTY
OUT OF YOUR PLANT
"All the King's Horses and all the King's Men" might have saved their reputations if they had known about electric welding.
This modern method of metal fabrication repairs breakdowns of vital production equipment "on the spot" without dismantling or waiting for hard-to-get replacement parts.
The superb features of versatile MARQUETTE Welders which give them such speed and economy on the production line make them ideal machines for the maintenance department.
LOW INITIAL COST • LOW COST OPERATION
NEGLIGIBLE UPKEEP • FAST, FLAWLESS WELDS • NO "MAGNETIC BLOW" • COMPLETE EQUIPMENT
Send for free, 24-page, illustrated booklet.
BUY THE BEST . . . BUY MARQUETTE
MARQUETTE MFG. CO., INC.
Minneapolis 14, Minnesota
MARQUETTE
a.c. arc welders

DALLETT

PNEUMATIC WELD-FLUX SCALING HAMMERS



Especially designed for roughing, peening, removing flux and excess metal resulting from welding operations.

- **made in several sizes**
- **button or lever type throttle**
- **safety chisel retainer**
- **smooth in operation**
- **light in weight**

write for Bulletin No. 500

THE DALLETT COMPANY

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PNEUMATIC AND HAND CHISELS ■ *"DALBO" AIR HOSE COUPLINGS*

"DALLETT" PNEUMATIC SAFETY RETAINER SHANK CHISELS

■ ■ *"DALWELD" DETACHABLE WELDING CABLE CONNECTORS* ■ ■

(Trade Mark Registered)

Doubly-Deoxidized Welding Alloys:

PENN BRONZE

TITAN BRONZE

TITAN MANGANESE BRONZE

Titan's Quality Control

ASSURES ABSOLUTE UNIFORMITY OF TITAN WELDING ALLOYS

Quality Control in manufacture of TITAN Welding Alloys begins with the selection of the finest available raw materials.

Only the purest raw materials are used: Electrolytic copper 99.96 plus in purity, and electrolytic zinc 99.99 plus. This assures the elimination of elements which if introduced would prove detrimental to quality and uniformity.

Maintenance of unvarying uniformity of mixtures and of casting temperatures, under strict laboratory control, further assures absolute uniformity of TITAN Alloys.

Descriptive literature sent upon request

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN WELDING RODS

Everett S. Lee, engineer, General Engineering Laboratory of the General Electric Co., has been elected chairman of the Engineers' Council for Professional Development. **James W. Parker,** vice-president and chief engineer of the Detroit Edison Co., was elected vice-chairman.

» «

Eight directors of the American Institute of Steel Construction have been elected to serve for three-year terms. These are: **Clyde G. Conley** (president of AISC), Mount Vernon Bridge Co., Mt. Vernon, O.; **Art J. Dyer,** Nashville Bridge Co., Nashville, Tenn.; **Henry Bohnsack,** International Steel Co., Evansville, Ind.; **Edward K. Klingelhofer,** Pittsburgh Bridge & Iron Works, Pittsburgh; **Clyde MacCornack,** Phoenix Bridge Co., Phoenixville, Pa.; **R. C. Mahon,** R. C. Mahon Co., Detroit; **P. F. Gillespie,** Judson-Pacific Co., San Francisco; **W. W. Wood,** Mississippi Valley Structural Steel Co., Decatur, Ill.

» «

Edward J. Burnell, formerly vice-president and general manager in charge of the Pershing Road plant of the Link-Belt Co., has been transferred to the company's executive offices as vice-president in charge of sales. **Harold L. Hoefman,** manager of the company's Atlanta plant, succeeds Mr. Burnell as general manager of the Pershing Road plant. **Richard B. Holmes** succeeds Mr. Hoefman at Atlanta, and **David E. Davidson** has been named district manager at Indianapolis to succeed Mr. Holmes.

» «

James B. Rosser, formerly sales agent, for the Pullman-Standard Car Mfg. Co., has been promoted to administrative assistant, reporting directly to the president.

» «

Herman Greenwood, for the past six years vice-president of the United States Steel Export Co., has been elected vice-president of Carrier Corp., Syracuse, N. Y., in charge of its international division.

» «

J. M. Darbaker has been appointed assistant manager of Chicago district operations of the Carnegie-Illinois Steel Corp., succeeding **R. G. Glass,** who recently became vice-president and general manager of the Geneva Steel Co., Provo, Utah. **Charles A. Ferguson,** formerly assistant general superintendent of the Gary Sheet and Tin Mill, succeeds Mr. Darbaker there as general superintendent.

» «

E. G. Plowman has been appointed vice-president in charge of traffic for United States Steel Corp. of Delaware, a newly created position. He has been traffic manager of the Colorado Fuel and Iron Co. since 1937.

» «

Effective with the transfer of the naval ordnance plant at Center Line, Mich., from its previous management to Westinghouse, **James R. Weaver** has been made manager. Mr. Weaver was formerly manager of the Louisville ordnance plant, which is also operated by Westinghouse. He is succeeded at Louisville by **C. E. Shiplet,** formerly superintendent of this plant.

» «

Charles H. Weaver has been appointed manager of the newly formed Marine Dept. of Westinghouse Electric & Mfg. Co. He was formerly manager of the Marine Section of the company's Industrial Dept.

» «

Peter L. Lenz, formerly manager of the Homewood Mfg. and Repair Plant, Pittsburgh, has been made manager of the Middle Atlantic District Mfg. and Repair Dept. of the Westinghouse Electric and Mfg. Co.

» «

Died. . .

Thomas A. Galvin, assistant district manager of the Chicago District of the National Cylinder Gas Co., died Thursday, Oct. 28. He had entered the compressed gas industry in the 1920's with the Burdett Oxygen & Hydrogen Co. of Chicago, remaining with the successor company until his death.

Even BULLDOZERS Need Repairing

● LeTourneau, who builds these irresistible monsters, knows they sometimes meet an immovable object. To permit repairs to be made right on the job—and to be sure they're made *right*—LeTourneau also builds the Tournacar Welders and equips them with Pierce Flyball Governors.

Pierce Flyball Governors bring to these portable units the sensitive, automatic speed regulation required for fast, sure welding. They hold the arc constant, and give split-second recovery of current characteristics . . . within three-tenths of a second after striking the arc!

To be sure of the weld . . . be sure the governor is Pierce . . . Pierce Flyball Governors—built by the world's largest governor manufacturer—will give you the maximum of service life and satisfaction.

THE PIERCE GOVERNOR COMPANY, INC.
1607 OHIO AVENUE • ANDERSON, INDIANA

NOW... and after the war... specify Pierce Flyball Governors on all of your welding equipment!

HOW TO MAKE YOUR GOVERNORS LAST!

Like others manufacturing for war needs, Pierce production is for war and essential industry. For this reason new governors can be supplied only on a priority basis. But Pierce calls attention to these easy measures which will make your present Pierce Governors last and give the best service.

- **CLEAN GOVERNORS** once a month with kerosene, gasoline, or prepared cleaner.
- **INSPECT AND CHECK GOVERNORS** each week when in continuous operation.
- **CHECK OIL LEVEL** every day in manually lubricated governors. Use the same grade oil as recommended for the engine.
- **LINE UP** driving pulleys or gears accurately when reassembling governor after cleaning.

Should your governor need repair or reconditioning send it to the factory with the necessary preference rating certificate.

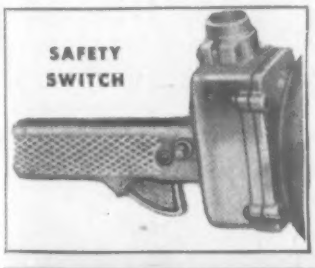
Pierce Governors
STANDARD SINCE 1915

FULL SPEED AHEAD!

with Stanley No. 566 Portable Grinder

Rugged, powerful and easy to use, the Stanley 566 Grinder will hurry up those war-needed jobs. Indispensable for grinding joints in tanks, boilers and large castings, for removing rust and scale, and snagging castings. Especially handy for grinding work too large to be taken to a bench grinder.

Grit-proof ball bearings, 6" wheel, safety guard, automatic release safety switch with locking device, eye-bolt for spring suspension where desirable. Write for complete details. Stanley Electric Tool Division, The Stanley Works, New Britain, Connecticut.



ARMY E NAVY

STANLEY

TRADE MARK

STANLEY ELECTRIC TOOLS

Saved...

Many Precious Man Hours

Recently a bronze flanged tube was required in a hurry. The use of Ampco-Trode 10 again solved the problem in a few short hours. A steel tube was welded to a bronze flange with Ampco-Trode 10.

This coated aluminum bronze weldrod is tops in its field, enabling you to weld steel, cast iron, brass, bronze, copper or nickel alloys.

Solve your fabrication problem—use Ampco-Trode 10 and get these physical properties in your weld:

TENSILE STRENGTH—60,000 to 70,000 per square inch.

DUCTILITY—25-30% elongation in 2" (.505 dia.).

Consult your Electrode Supplier

or write

ARMY E NAVY

AMPCO METAL, INC.

Department WR-12

Milwaukee 4, Wisconsin

Helpful Literature Just Published

The following reviews are of recent publications of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

Stock List

A new 248-page, 5¼ by 9 in. "Stock List and Reference Book" has just been issued by the **United States Steel Supply Co.** (formerly Scully Steel Products Co.), 1319 Wabansia Ave., Chicago 90, Ill. This book is No. 1 under the company's new name, and in it are listed the stocks of steel, steel products, tools, equipment and machinery handled. Side index tabs permit the quick selection of any class of material desired, and there is also a two-page general index. Several pages of welding electrodes and welding accessories are included.

» «

Help for Engineers

Engineers who have trouble with the idiosyncrasies of spelling, punctuation, capitalization, abbreviation, sentence structure, etc. should find "How to Prepare an Engineering Report" helpful. This 72-page, letterhead-size guide book tells the engineer most of what he needs to know in order to put his facts, findings and conclusions into convincing form. The information is arranged according to such chapter headings as: "factors to consider in writing an engineering report," "qualities of an engineering report," "sources of engineering and operating data," "efficient methods for taking notes," "methods of analyzing report data," "preliminary planning of the report," "writing the report," "styling the report," "mechanical layout of the report." A copy of this book, Report No. 399, may be obtained without charge by writing to the **Alexander Hamilton Institute,** Dept. P, 71 W. 23rd St., New York City 10.

» «

Salvage Manual

The first comprehensive manual on industrial salvage ever prepared has been completed by the Technical Service Section, Industrial Salvage Branch, Salvage Div., War Production Board. The 250-page, 6 by 9 in. "Salvage Manual for Industry" contains 26 chapters of systematically organized and classified information on industrial salvage practice. There are two chapters on organizing and planning the salvage department, three on the administrative factors, twelve on methods of finding, identifying, segregating, collecting, reclaiming, storing and selling metal scrap, as well as much other useful information. The volume was prepared and edited by an editorial board of seven engineers, who were assisted with either direct contributions or advice by a corps of some 40 engineering and salvage experts. It may be obtained at a price of 50c from the **Supt. of Documents,** Government Printing Office, Washington, D. C.

» «

Underwater Cutting Booklet

An eight-page, letterhead-size bulletin has been issued to describe the Victor Model 3900 underwater cutting torch (see page 85, THE WELDING ENGINEER, November, 1943). Instructions are included for lighting and operating the torch below the surface, and some general information concerning underwater cutting is given. The final page is devoted to a detailed list of replacement parts for this model of cutting torch. **Victor Equipment Co.,** 844-54 Folsom St., San Francisco.

» «

Positioner Leaflet

Lyon-Raymond's Circular 134, a two-page, letterhead size leaflet, briefly describes the company's general line of material handling equipment. Hydraulically operated welding positioners and elevating tables are among the products illustrated. **Lyon-Raymond Corp.,** 1410 Madison St., Greene, N. Y.

Here's what makes
BRIDGEPORT BRONZE WELDING RODS
"Equal to any Job...worthy of your skill"
Bronze WELDING ALLOYS
FACTS for WELDERS ...Practical, up-to-the-minute data. How to select and use bronze welding rods for best results. It is yours free by writing Bridgeport.

Low melting point—easy flow—good tinning action—smooth, easy machinability—these are some of the features of Bridgeport Bronze Welding Rods. Put it down to the uniformity of these rods...to reliable, workable qualities...to the metallurgical research and development of 78 years experience. It all adds up to strong, dense, tough welds that meet the maintenance and repair requirements for large or small parts. For salvaging broken machinery, the country owes much to the welder for speeding the war effort. To get the best in welding rods—specify "Bridgeport."

BRIDGEPORT BRASS

"Bridgeport" BRASS

BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN.

ESTABLISHED 1865

National
Carbide

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EFFICIENT

ECONOMICAL

DEPENDABLE

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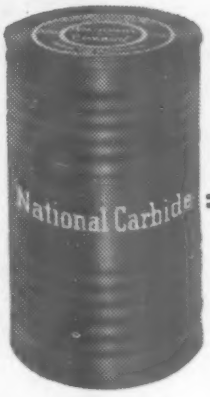

For
Welding and Cutting
Specify

NATIONAL CARBIDE IN THE RED DRUM

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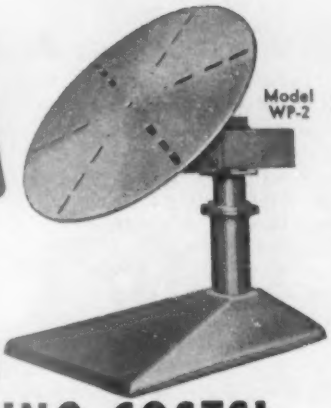
NATIONAL CARBIDE CORPORATION
60 E. 42nd St., New York, N. Y.

P&H
WELDING
POSITIONERS



NEW!
LOW PRICED!
CUTS WELDING COSTS!

- 2500 pound capacity at surprisingly low cost.
- All-welded rolled steel construction.
- Most versatile positioner in its class. Simple and easy to operate.
- Large table area with handy slots.
- Hydraulic power tilting.
- No exposed gearing.
- Manual turning to suit welding speed. Positive table locking device.
- Telescopic elevation.
- Portable or column-in-floor mounting.
- Also available with handwheel or power turning.

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General Offices: 4513 West National Avenue, Milwaukee 14, Wis.

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CORPORATION
ARC WELDERS • EXCAVATORS • ELECTRIC CRANES P&H MOTORS • HOISTS • WELDING ELECTRODES

Canadian Distribution: The Canadian Fairbanks-Morse Co., Ltd.

HOW TO PROTECT
VALUABLE EQUIPMENT

BERGSTROM Electrodes deposit a layer of extra-tough metal over points of abrasion and impact. Thus they prevent premature wearing out of equipment. This saves valuable time and money.

These electrodes are easy to use. They can be applied in any position. Slag-free—chipping and brushing are eliminated. Several types—each designed to match a specific need for resistance to abrasion or abrasion and impact, also corrosion.

MANGALOY
—For welding manganese steels.

FLEXALOY
—A tough, hard overlay—unusually ductile.

RANALLOY TYPE "C"
—Low priced—for ordinary wearing conditions.

RANALLOY TYPE "A"
—Medium priced. Deposits tough, hard overlay metal.

RANALLOY TYPE "B"
—Super hardness for extreme abrasion resistance.

SUPRALOY
—Ultra hard rod. For maintenance of an edge or sharp corner.

COROSOLOY
—Corrosion-resisting rod.

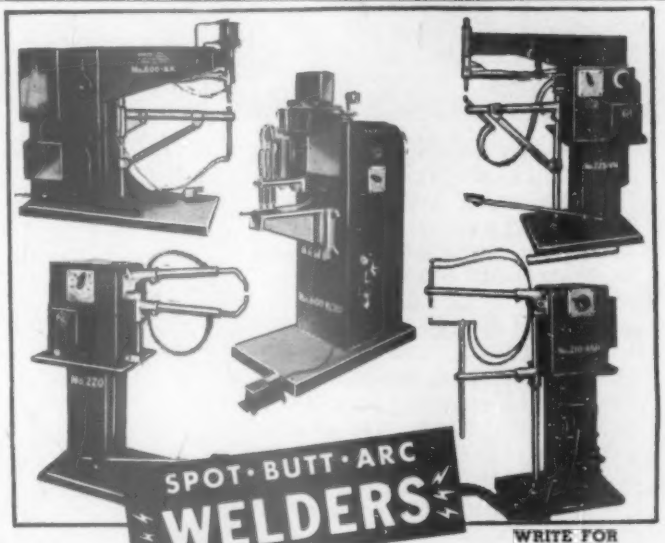
BERGSTROM *Free Flowing*
HARD SURFACING ELECTRODES

Write us for further information

UNITED STATES STEEL SUPPLY COMPANY

CHICAGO (90) · BALTIMORE (3) · BOSTON (34)
CLEVELAND (14) · MILWAUKEE (1) · NEWARK (1), N. J. · PITTSBURGH (12) · ST. LOUIS (3)
TWIN CITY-*St. Paul* (4)

UNITED STATES STEEL



SPOT · BUTT · ARC
WELDERS

WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
749-SO. 13th ST. Near AVON AVE. NEWARK, 3 N. J.

X-Ray Booklet

"Industrial Inspection with X-Ray Equipment" is the title of a new 38-page, 11 by 8½ in. booklet published by the Westinghouse X-Ray Division. This book tells how X-ray pictures are made and used, how to select X-ray equipment, how to plan an X-ray inspection department for: (1) light alloys, (2) heavier metals, (3) with mobile equipment, (4) for production lines. A chapter on "New X-Ray Developments" describes two important innovations: an ultra-high speed X-ray unit, with which it is possible to take radiographs in the incredibly brief period of one-millionth of a second, and the use of miniature film, handled in continuous strips, to speed the production and keep down the cost of radiographs used for industrial inspection. **Westinghouse Electric & Mfg. Co., X-Ray Div.,** Baltimore, Md.

» «

"Specification Selector"

This is a 26-page, 4¼ by 6¾ in. booklet designed to make it easy to select a grinding wheel conforming to stipulated general specifications. Eight general classes of wheels are covered: portable wheels, internal wheels, centerless wheels, snagging wheels, segmental wheels, cut-off wheels, cylindrical wheels and tool room wheels. There is also a wheel marking analysis chart. Sterling **Grinding Wheel Division,** Box 201, Tiffin, O.

» «

Study on Absenteeism

"What Management Can Really Do To Reduce ABSENTEEISM" is the title of a comprehensive 28-page, letterhead-size study by the **George S. May Business Foundation,** 111 So. Dearborn St., Chicago. This discusses the problem from the points of view of both worker and management and cites tried ways of reducing Absenteeism that have been reported from plants all over the country.

» «

Steel Products Manual

"Carbon Steel Structural Sections" is a revised edition (as of August, 1943) of Section 4 of the Steel Products Manual, a section originally issued Dec., 1938. The 50-page 6 by 9 in. booklet covers general definitions and manufacturing practices of structural shapes, chemical limits and ranges, permissible variations for check analyses, methods of sampling, permissible variations for dimensions and workmanship, standard methods of loading and the National Emergency simplified list of structural steel sections. Available at 25c, postpaid, from the **American Iron and Steel Institute,** 350 Fifth Ave., New York City.

» «

Eutectic Alloy Booklet

An eight-page, letterhead-size folder published by the **Eutectic Welding Alloys Co.,** 40 Worth St., New York City 13, catalogs the various Eutectic welding rods and indicates their general purposes. It describes the rods which are available for: (1) cast iron, (2) steel castings, forgings, shapes tubes and sheets, (3) nickel and Monel castings, forgings, shapes, etc., (4) brass, bronze, copper, (5) aluminum, (6) magnesium and Dow metal (7) zinc-base die castings, (8) building up protective coatings on parts subject to frictional wear, (9) building up protective coatings on parts subject to abrasive wear.

» «

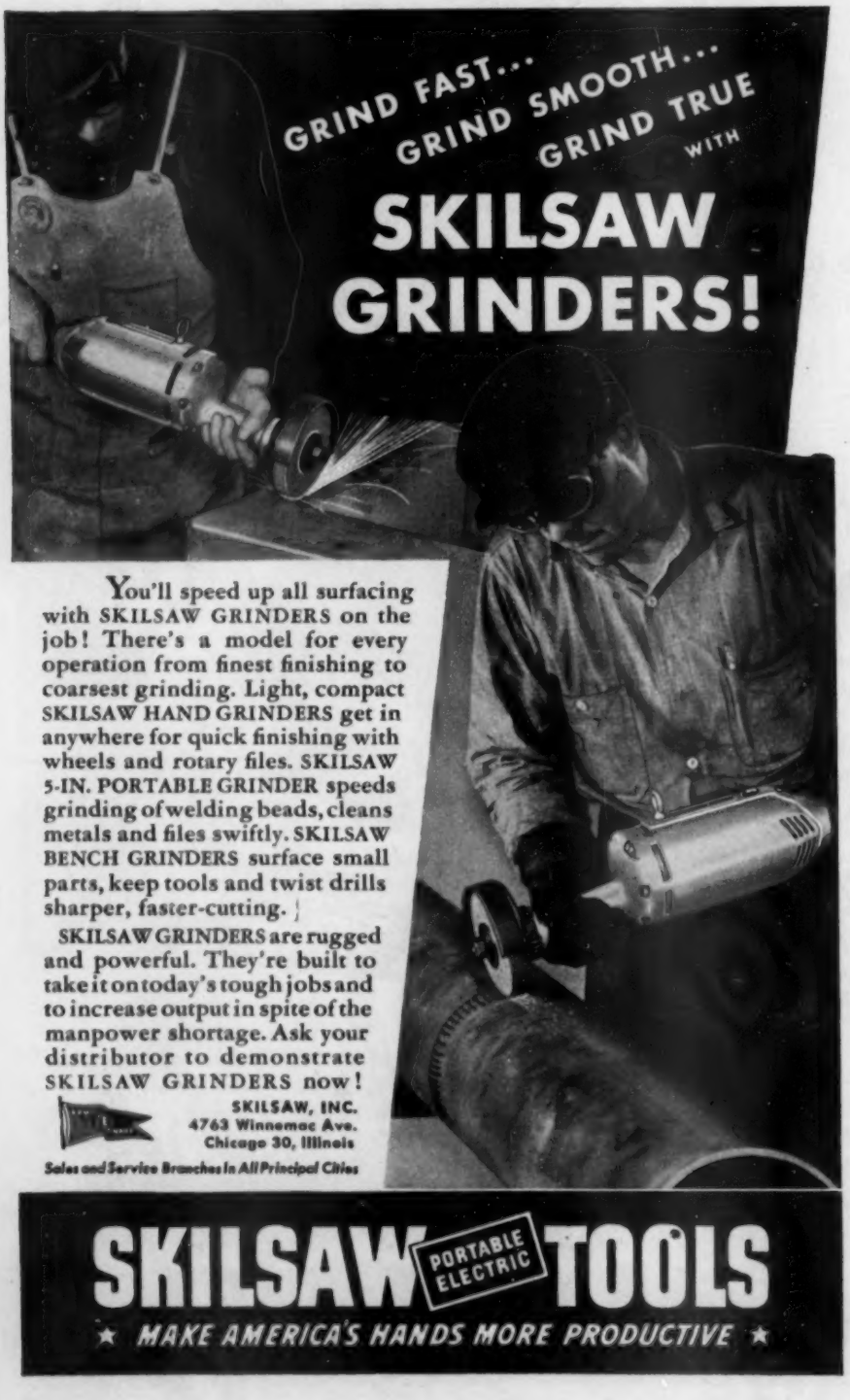
Carbide Tool Bulletin

Tungsten Carbide Tool Co., 2661 Joy Road, Detroit 6, is now issuing a regular series of bulletins on tungsten-carbide-tipped stock and semistock tools. "Stock Tool Bulletin No. 43-1," the first in the series, is devoted to hardened reamers of both the straight and tapered shank types.

» «

Fire Extinguisher Booklet

A booklet describing a line of portable and built-in carbon dioxide fire extinguishers and auxiliary equipment has just been issued by the **C-O-Two Fire Equipment Co.,** U. S. Highway No. 1, Newark.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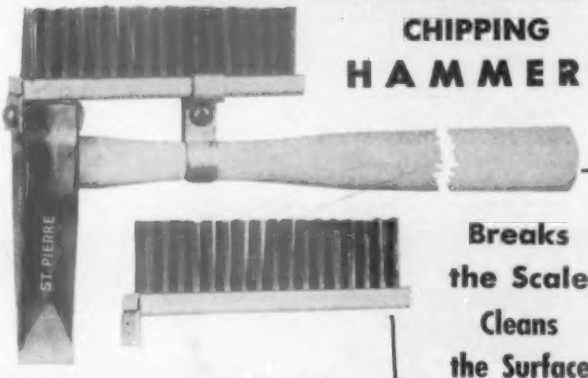

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Safety Aids

To assist in the current campaign against industrial eye accidents, the American Optical Co., is making available a number of free safety promotion services. These include: (1) safety posters dramatizing the importance of wearing goggles on eye-hazardous jobs; (2) a miniature newspaper, *The Safety Clipper*, containing material for reproduction in employee magazines or newspapers; (3) analyses of plant eye hazards and recommendations for eye-protection programs; (4) a 16 mm sound training film, *Right on the Nose* (see page 106, THE WELDING ENGINEER, Oct., 1943) and a booklet bearing the same title which provides in printed form the information contained in the film. Further information regarding any of the above services can be obtained by addressing the **American Optical Co.**, Southbridge, Mass.

» «

Pipe Bending Handbook

An 80-page manual of methods and devices for bending pipes and tubes of copper and copper alloys has been prepared by the **Copper & Brass Research Association**, 420 Lexington Ave., New York City 17. The text covers such subjects as hot and cold bending, minimum radii, temper, the use of mandrels of various types, bending with the aid of filler materials (sand, rosin, salt), smooth and wrinkle bending of large diameter pipe, etc. There are 113 figures and illustrations.

» «

A-C Welder Folder

Benefits to war industry of the new Ampac "400" A-C welder are outlined in the recently published 4-page, letterhead-size Bulletin B-6302. In addition to providing detailed specifications, this publication has an attractive pictorial section to show the construction of each major part of this continuously variable heavy-duty welder. Electrical performance data at all loads are also given. **Allis-Chalmers Mfg. Co.**, Milwaukee.

» «

Pressure Vessels

A 20-page, letterhead-size pictorial booklet has been published by the John **Nooter Boiler Works Co.**, 1400 South Second St., St. Louis 4, to discuss the welded fabrication of pressure vessels, exchangers, coolers, fractionating columns, tanks and kindred equipment. Pictured are typical products of silver and silver clad steel, Hastelloy (nickel-base) alloys, silicon bronze, stainless and stainless clad, aluminum, Monel and other materials.

» «

Grinder Folder

This two-color mailing piece unfolds to 17 by 21½ in. in order to picture in detail the construction of the new Norton Type C universal multipurpose grinder and show typical jobs for which it may be used. Specifications are given regarding capacity, size of grinding wheels, headstock, footstock, wheel head, wheel spindle, wheel feed, sliding table and traverse speeds, motors, etc. **Norton Co.**, Worcester 6, Mass.

» «

Hack Saw Catalog

Star Catalog No. 43-S contains technical data on metal-sawing operations as well as information regarding the Star line of hack saw blades, frames, power saws and band saws. **Clemson Bros., Inc.**, Middletown, N. Y.

» «

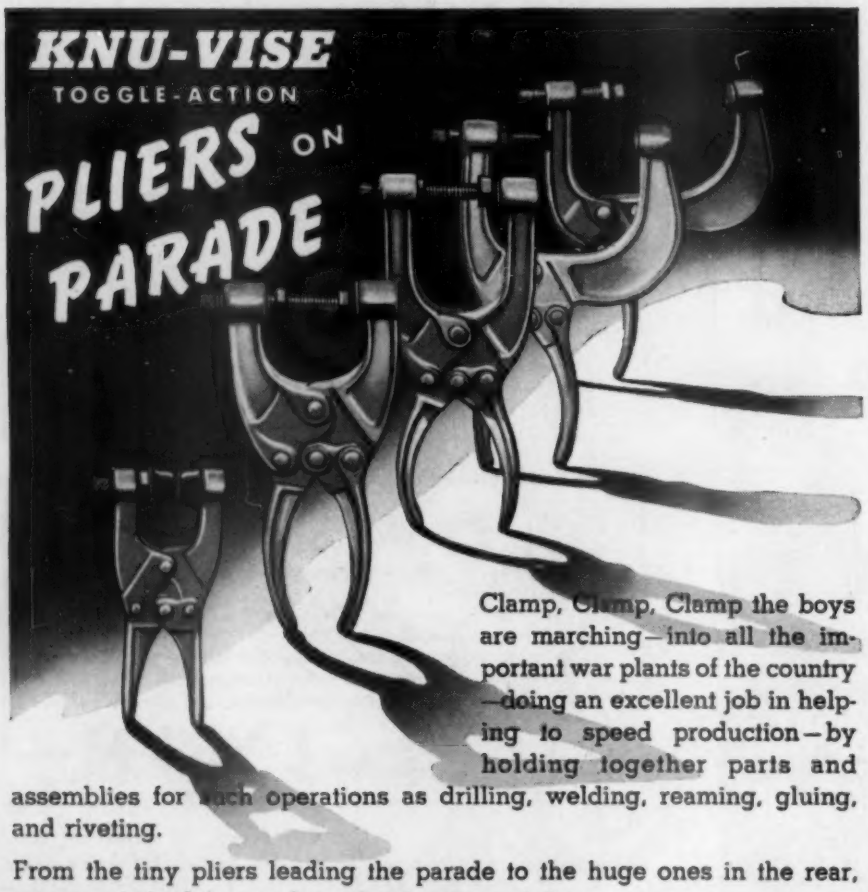
Soft Hammer Folder

A folder 3¾ by 8½ in. describes the Metocraft line of soft alloy hammers weighing from 1 to 6 lb. **Industrial Products Suppliers**, 2 Broadway, New York City 4.

» «

Safety Study

To assist in formulating a safety program for the woman worker, the Metropolitan Life Insurance Co. has issued a report entitled "Safeguarding the Woman Employee." Copies of this study are available to executives who write on their business stationery to the **Policyholders Service Bureau, Metropolitan Life Insurance Co.**, 1 Madison Ave., New York 10.



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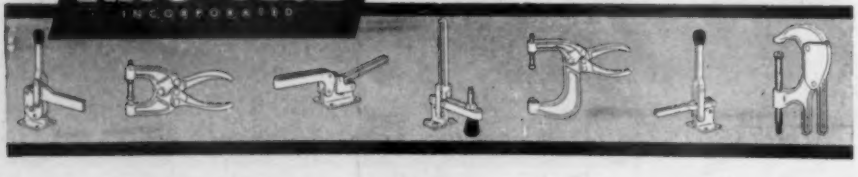

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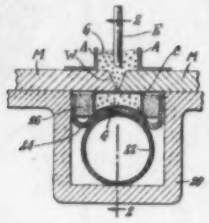
FROM THE PATENT OFFICE

Submerged Melt Welding

2,331,937. **Norman G. Schreiner,** Philadelphia, assigned to **The Linde Air Products Co.** Filed April 17, 1940. Issued Oct. 19, 1943.

In this welding method, molten metal is progressively deposited along a seam between the opposed edges of two juxtaposed metallic members to produce a welded joint. The side of the seam opposite to that along which the metal is deposited is bridged and enclosed with

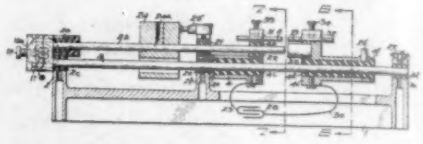


a non-adhering mass of unbonded granular mineral material that is both refractory and fusible. This material is contained within an elongated tubular flexible casing of fabric which is completely combustible at the temperature of the molten metal. The casing extends longitudinally of the back side of the seam and is pressed into bridging engagement with the side of the seam opposite to that along which the molten metal is deposited. It also extends against the metal members for a substantial distance on each side of the seam.

» «

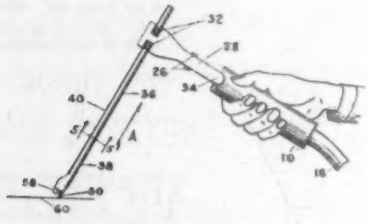
Flash Welder

2,332,581. **Theodor B. Kohler,** Detroit. Filed Aug. 7, 1942. Issued Oct. 26, 1943.



A flash welding machine with two carriages which are relatively movable toward one another. Each carriage supports a work piece, and the carriages are moved towards each other by mechanical means to permit a discharge between the work pieces before they come into physical contact. The electric circuit includes a condenser to store energy for this discharge. A mechanical shock is imparted to one work piece while the discharge is taking place, and the two work pieces are then moved into physical contact by mechanical means.

« »



Training Device

2,333,192. **Carl E. Moberg,** Worcester, Mass. Filed Oct. 29, 1942. Issued Nov. 2, 1943.

A device for training weldors without consuming actual electrodes. Simulating the electrode is a non-fusible rod movably mounted on a support; this rod is moved automatically away from the support at a rate of speed approximating the speed of melt of a welding electrode.

« »

Welding Glove

2,333,594. **George L. Smither, Jr.,** Wilkinsburg, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa. Filed May 6, 1941. Issued Nov. 2, 1943.

A leather weldor's glove having a wearing surface striated by a multitude of cuts. These form many relatively small projecting areas. During use, each of these projections is surrounded on four sides by air and is thus subjected to the effects of use only at its upper side.

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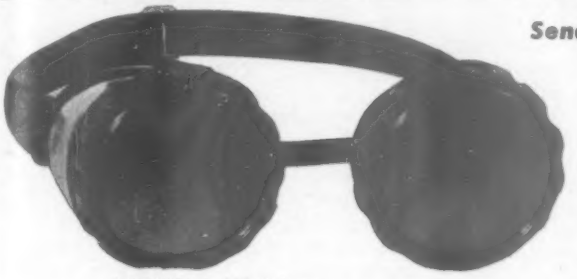

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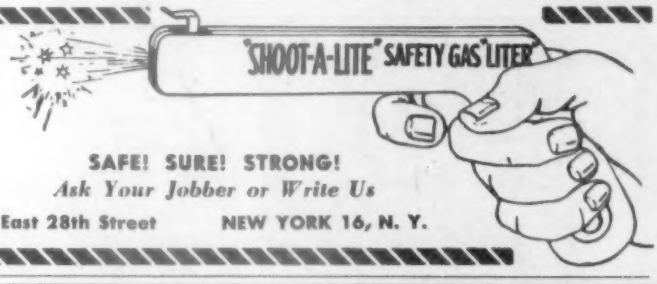

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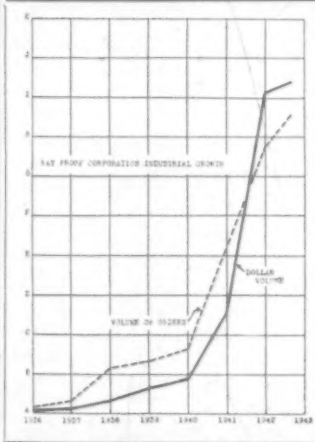

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(In Canada: Safety Supply Co., Toronto)

Grinding Wheel

2,332,241. **Robert H. Lombard** and **Lowell H. Milligan**, Worcester, Mass., assigned to the **Norton Co.**, Worcester. Filed Dec. 6, 1941. Issued Oct. 19, 1943.

An abrasive wheel of oxidizable abrasive grains bonded with a vitrified borosilicate bond. The latter includes from 40 to 70% silica, from 2 to 20% of oxide selected from the group consisting of zirconia and titania, not more than 30% of alumina, from 2 to 15% of alkaline earth oxide, from 5 to 25% of boron oxide and from 0.5 to 5% of alkali metal oxide, all percentages being by weight on the entire vitrified bond.

» «

Sandblast Nozzle

2,332,281. **Edward Van der Pyl**, Holden, Mass., assigned to **Norton Co.**, Worcester, Mass. Filed Dec. 12, 1940. Issued Oct. 19, 1943.

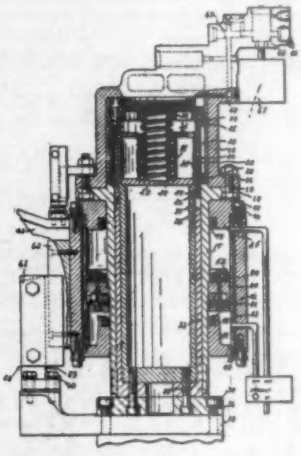
A nozzle for sandblast apparatus comprising a liner of hard molded material having a cylindrical outer surface. The latter is unmodified by flanges or recesses and has a bore which is a surface of revolution. Liner is peripherally encompassed by a rubber sleeving having two inwardly extending flanges, one at each end, for overlying the two annular end faces of the liner. Outside of the rubber sleeve is a metal sleeve having a portion coacting with the external flange in order to clamp the nozzle to a hose. The liner is held against relative axial movement by the inwardly extending rubber flanges.

» «

Abrasive Wheel

2,334,049. **Edward Van der Pyl**, Holden, Mass., assigned to the **Norton Co.**, Worcester, Mass. Filed Dec. 1, 1941. Issued Nov. 9, 1943.

A cup-shaped abrasive wheel comprising a metal ring base part and a metal-bonded abrasive part, these two parts being integrally united into a jointless unit. The abrasive part has a true annular abrasive surface into which fits an annular dove tail formed on the base part.



Spot Welding Apparatus

2,329,851. **Henry Thomas Platz**, Detroit, assigned to **Briggs Mfg. Co.**, Detroit. Filed March 30, 1942. Issued Sept. 21, 1943.

A spot welder having a head provided with a cylinder and piston. The piston is normally held in a retracted position adjacent one end of the cylinder but is movable by fluid under pressure towards the opposite end. The electrode connected to the piston is thus brought into engagement with the work to be welded. There is also a second piston which is concentric with the axis of the first piston and operates (in the retracted position of the first piston) in a direction to displace the head (together with the first piston and electrode) in a direction to increase the clearance between the work and electrode.

MANGANAL

(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945)

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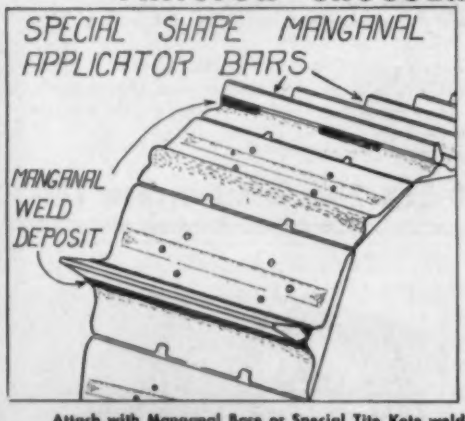

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DEALERS: Regular discounts in quantity
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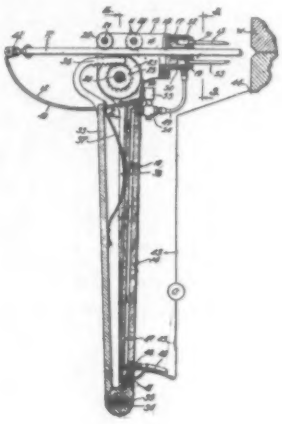
Gas-Shielded Arc Welding

2,329,904. **John H. Howard,** Whittier, Calif. Filed Sept. 26, 1941. Issued Sept. 21, 1943.



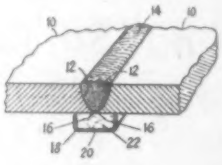
This device comprises a body having a handle and a head carrying a welding electrode. Gas is supplied to the arc zone through a discharge means at the head and a gas-conducting means leading to the discharge means.

» «

Tube Welding Method

2,331,689. **James C. Hodge,** Akron, O., assigned to **The Babcock & Wilcox Co.,** Newark. Filed April 29, 1941. Issued Oct. 12, 1943.

In this process, the end portions of tubes are arranged in contiguous relation to form a circumferential welding seam in which weld metal is deposited to form a welded joint. The steps covered are the forming of the tube ends to provide an annular groove and the filling of the groove with a material comprising metallic particles bonded together in a compact friable mass to inhibit the flow of weld metal from the seam. The filling material extends from the bottom of the groove for a distance sufficient in relation to the heat used in the welding operation to insure only partial penetration of molten welding metal from the seam.



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Soldering Composition

2,333,989. **George G. Diem,** Lock Haven, Pa. Filed May 14, 1942. Issued Nov. 9, 1943.

A solder composed of tin by about 60.6% by weight, zinc by about 34.8%, wax by about 1.5% and stearic acid by about 1.5%.

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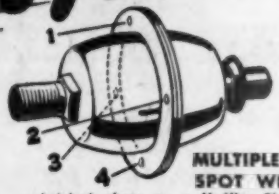

MULTIPLE SPOT WELDING sketched above on a Muffler Shock Insulator Assembly, made possible a welding rate 4 times greater than could have been reached by individual welds. A special die designed to weld points 1, 2, 3, and 4 (above) at one contact made this possible. The older way would have been to weld point 1, turn the piece, weld point 2, turn the piece again, etc.

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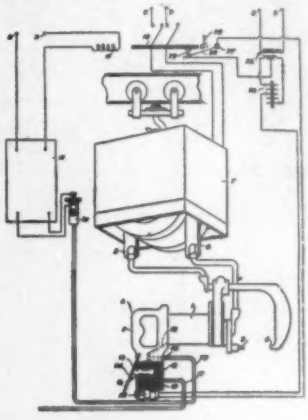
Gun Welding Apparatus

2,330,465. **Algernon Edward Berriman,** Oxford, England, assigned to **Pressed Steel Co., Ltd.,** Oxford, a British company. Filed (in United States) April 1, 1939. Issued Sept. 28, 1943.

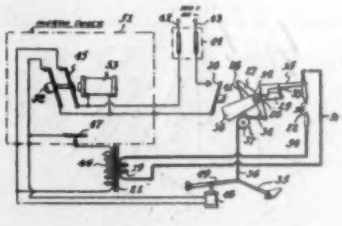


A welding apparatus of the kind wherein welding dies are moved relatively to one another and held in contact with the work through the medium of a pressure fluid. Elements are: a movable contact breaker for the welding current circuit, a timing device to determine the time interval between the make and break movements of the contact breaker, a manual control for starting and stopping the flow of the pressure fluid that causes the dies to move relative to each other, and an electromagnetic device for maintaining the manual fluid pressure control (as set by the operator at the commencement of a welding operation) for a period in excess of that during which welding current flows. The latter device is unlocked by means dependent upon operation of the circuit breaker.

» «

Spot Welding Timer

2,330,055. **Gilbert C. Holloway,** deceased, late of Bloomfield, N. J., by **Janet G. Holloway,** executrix, assigned to **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa. Filed Nov. 19, 1940. Issued Sept. 21, 1943.



A timing device for a resistance welding system. The circuit includes a switch and inertia timer having a solenoid; the switch is operated to close the circuit by cam means operable after the electrodes become engaged. When circuit is closed, the current passing between the electrodes is utilized to energize the solenoid. Current is thus allowed to flow between the electrodes only until the inertia timer solenoid can act to open the circuit.

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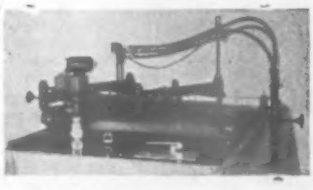

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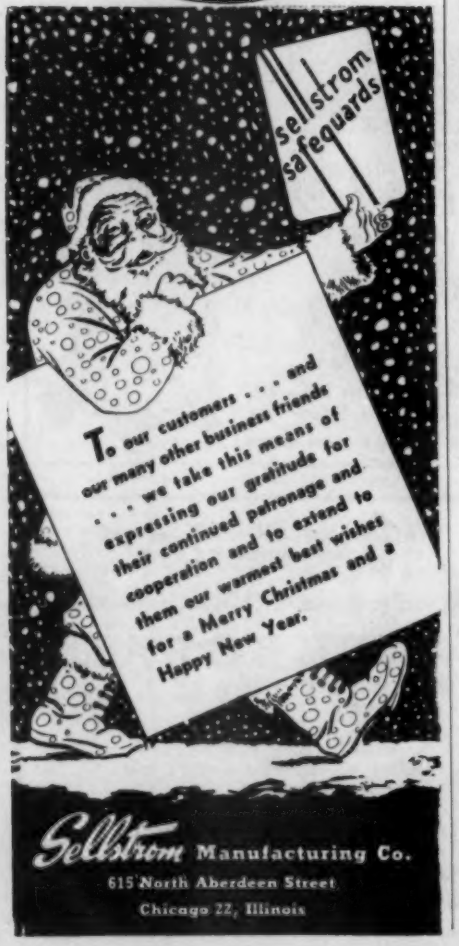
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Electrode Holder

2,330,931. **Roy M. Stafford,** Beaumont, Tex. Filed June 4, 1942. Issued Oct. 5, 1943.

In this electrode holder, a swivelly mounted contact member is used to make the electrical connection with the electrode. The latter is forced with a rotative action against the contact member so as to improve the electrical contact. The contact member has a cylindrical head with a circular flat end face to provide a line contact across its diameter and so hold the electrode against tilting movement.

» «

Welding Rod and Manufacture

2,333,811. **Leopold Neumann,** New York City, assigned to **Multiprises, Inc.,** New York City. Filed Nov. 14, 1941. Issued Nov. 9, 1943.

This patent covers a welding rod with a longitudinally folded metal casing and a compressed flux core. The rod is made by folding a fluted strip having a number of approximately equal arcuate longitudinal thick portions, with a radius of curvature to form a circle when folded together, and intervening thin portions. When strip is folded along the thin portions, there is formed a square trough into which flux is introduced. Closing the strip forms a triangular interior and a circular exterior. The flux is compressed in the closing operation.

» «

Spot Welding Circuit

2,329,977. **Paul E. Brunberg,** Detroit, assigned one-half to **Nita Carol Brunberg** and one-half to **Robert A. Choate,** both of Detroit. Filed Oct. 9, 1941. Issued Sept. 21, 1943.

A resistance welding circuit comprising a low frequency primary coil for A-C, a secondary coil, a secondary condenser and electrodes. The latter are connected respectively to one end of the secondary coil and to one end of the condenser, which is made up of sheaves of metal wound with the secondary coil.

» «

Stainless Electrode

2,329,986. **John Anthony Goodford,** Belleville, N. J., assigned to **Crucible Steel Co. of America,** New York City. Filed April 6, 1942. Issued Sept. 21, 1943.

A coated welding electrode having an austenitic steel core containing about 10% to 25% chromium and about 6% to 15% nickel. The coating contains sufficient molybdenum to produce a weld deposit containing about 1.25% to 5% of this element.

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YOUR 1943 INDEX of THE WELDING ENGINEER

Volume 28 — January to December inclusive

AUTHORS

Adams, C. O., Nov., 38.
Adams, W. E., May, 41.
Barrett, John C., Nov., 39.
Bell, F. L., Sept., 40.
Benyo, E., Nov., 38.
Berg, H. F., Nov., 70.
Boese, William, Dec., 46.
Bowen, W. B., Nov., 39.
Brendle, R. W., Nov., 74.
Brooking, Walter J., Feb., 38; Mar., 34; May, 48.
Cable, J. Wesley, Apr., 39.
Clark, Nathan C., Nov., 78.
Clason, Clyde B., Jan., 31; Mar., 96; Apr., 29; May, 48; June, 34; Oct., 35.
Cleeland, Robert, Dec., 60.
Cripe, R. W., Nov., 64.
Curtois, Charles, July, 66.
Deily, R. L., Nov., 38.
Diebold, J. M., Nov., 39.
Dunn, F. W., Dec., 43.
Eads, Irene, July, 37.
Elliott, H. C., Mar., 110.
Fetcher, J. R., Nov., 39.
Flint, A. W., Jan., 54.
Flint, Lucius S., Sept., 48.
Foege, H. W., Sept, 44.
Forsyth, John A., Aug., 37.
Gillette, R. T., Jan., 44.
Goetjen, C. R., May, 40.
Gorham, L. C., May, 35.
Grover, La Motte, Jan., 40; Feb., 34.
Gruner, A. M., June, 40.
Halsey, W. D., Nov., 76.
Hanford, R. I., Feb., 60.
Harder, Oscar E., Nov., 39.
Havens, Arthur, Feb., 52.
Herres, S. A., Nov., 39.
Hess, W. F., Nov., 39.
Holslag, C. J., Feb., 58.
Jefferson, T. B., Jan., 27; June, 46; July, 38; Aug., 31; Oct., 35.
Jennings, L. D., Sept., 34.
Johnson, Gene, July, 49.
Johnson, W. A., Nov., 78.
Jones, F. G., Nov., 51.
Kenefic, J. W., Nov., 38.
Kerwin, Harry, July, 59; Sept., 42.
Kielb, Joseph V., Mar., 38.
Kohlbry, R. L., Nov., 40.
Kugler, A. N., Nov., 76.
Lawson, T. R., Feb., 42.
Loose, W. S., Jan., 46.
Lynde, Charles C., June, 58; Aug., 58; Oct., 70; Nov., 64; Nov., 72; Dec., 72.
McComb, R. D., Nov., 38; Dec., 49.
Miller, Dr. John L., Jan., 36.
Munson, A. L., Aug., 41.
Neidhart, John J., Nov., 56.
Orban, A. R., Jan., 46.
Palmer, H. L., May, 51.
Pate, M. T., Jan., 35.
Pfeil, A. L., Apr., 36.
Pickhaver, L. G., June, 42.
Pruett, W. A., Oct., 72.
Quinn, G. C., Sept., 52.
Quinn, Roy J., Feb., 31.
Renn, Alan C., May, 38.
Saunders, J. H., Sept., 48.
Schuman, Joseph, May, 62.
Setapan, A. M., Aug., 47.
Sherbo, John G., June, 38.
Simons, Eric N., July, 63.
Smith, C. B., Nov., 46.
Smith, G. H., Mar., 31.
Spangler, F. L., Mar., 108.
Stephenson, John, Nov., 64.
Stevenson, Francis H., Apr., 44.
Steward, C. W., Nov., 78.
Stonecipher, O. J., July, 44.
Thomson, Alfred J., Dec., 66.
Van Den Beemt, J., Nov., 39.
Voldrich, C. B., Nov., 39.
Vreeland, J. J., Nov., 42; Dec., 56.
Wald, Alfred A., Oct., 76.
Waldo, Forrest, June, 31.
Young, E. G., Nov., 38.

FEATURE ARTICLES

A

A. D. C. Welding in Britain, July, 63.
Aircraft: Applying Flash Welding to Airplane Construction, Nov., 46.
Aircraft, Applying Welding to, Apr. 44.
Aircraft: For The Air War, Oct., 36.
Aircraft: Spot Welded Superchargers, Nov., 66.
Aircraft Spot Welding, Nov., 78.
Aircraft: Welding Bell Airacobras, Aug., 37.
Aircraft: Welded Boring Bar, Nov., 64.
Aircraft: Welded Tubular Fuselages, May, 38.
Alloy Steels, Evaluating Weldability, Nov., 39.
Aluminum Alloys, Spot Weld Joint Efficiency for, Nov., 78.
Aluminum Castings Salvaged, Aug., 52.
Aluminum Spot Welding Faults, Mar., 31.
Amphibians For Landings, Oct., 46.
Ancient Arc Welder, June, 56.
Arc Stabilizer: "Trail-Blazing" Arc Path, Nov., 68.
Arc Welded Die, June, 58.
Arc Welded Locomotive Repairs, Feb., 52.
Arc Welder, Ancient, June, 56.
Arc Welding, Helium-Shielded, Oct., 66.
Arc Welding Magnesium Alloys—Part II, Jan., 46.
Arc Welding: Welded Drum Spiders, Oct., 70.
Argentine Welding job., Dec. 71.
Armament: Capsule for Hitler, July, 59.
Armament: For The Ground War, Oct., 38.
Armament: Welded Bofors Anti-Aircraft Gun Carriages, Jan., 36.
Armament: Welding at War, Oct., 35.
Armament: Welding M-4 Tank Hulls, Dec., 46.
Armament: Welding Weapons for Victory, Feb., 31.
Articulated Induction Coils, Dec., 60.
Artist Turns Weldor, Oct., 74.
Atomic-Hydrogen Welding, May, 56.
Atomic-Hydrogen Welding, June, 42.
Australian Welded Trailer, Dec., 66.
AWS: Convention in Chicago, Oct., 49.
AWS Meeting, Twenty-Fourth, Nov., 35.
AWS Papers in Digest Form, Nov., 38

B

Battery Charger to Welder, July, 66.
Blind War Workers, Dec., 71.
Boiler: Buffer Bars for, Oct., 70.
Boiler Stacks, Welded, July, 52.
Boiler, Welded Locomotive, Nov., 38.
Bolts, Hard-Facing Railroad, Jan., 54.
Bolt Saver, July, 54.
Boring Bar, Welded, Nov., 64.
Brazil, Welding in, Oct., 66.
Brazing a Broken Gate Valve, Sept., 42
Brazing Copper Bars, Dec., 72.
Brazing, High Frequency, Feb., 60.
Brazing, High Frequency Tool, July, 43.
Brazing, Incandescent, May, 59.
Brazing, Silver Alloy, Aug., 47.
Brazing Speeds Bomb Output, Feb., 56.
Brazing Tipped Tools, Apr., 52.
Brazing Tongs, Silver, Mar., 114.
Brazing Torch, Duplex, Aug., 54.
Brazing a 7,100 Hp Turbine Speed Ring (Part I), Apr., 29., Part II, Mar., 48:
Buffer Bars for Boiler, Oct., 70.

C

Carbon Paste, Molding with, Dec., 48.
Carrier, Pipe and Rod, Aug., 57.
Casings, Welding Well, Mar., 114.
Castings Salvaged, Aluminum, Aug., 52.
Chipping: Let Us Not Go Backwards, Feb., 58.
Circuit, New A-C Welding, Sept., 52.
Cleaner Repairs, Air, Aug., 58.
Cleaning Method, Torch, June, 50.
Cleaning Torch Tips, Apr., 52.
Clinic, Why Not A Welding? Mar., 38.
Composite Tools, Welded, June, 40.
Control of Welding in Shipbuilding, Nov., 74.
Controls for The War Effort, May, 51.
Controls, Types of Electronics, Feb., 42.
Convention in Chicago, Oct., 49.
Copper and Copper Alloys, Welding Methods for Nov., 42., (Part I); Part II, Dec., 56.
Copper Plate, Gas Welding, July, 44.
Copper-Saving Electrode, Nov., 64.
Copper to Steel, Welding, Oct., 76.
Correcting Distortion in Large Structures, Feb., 34.
Crane Girders, Welding Big, Nov., 40.
Crossover, Pipe June, 58.
Crushed, But Not Leaking, Apr., 55.
Cutting a Seven-Ton Slab, Sept., 56.
Cutting Shears, Plate, June, 58.
Cutting Tank Sprockets, May, 59.
Cutting Tool Absenteeism, Ending, Sept., 44.
Cylinder Heads, Salvaging, July, 59.
Cylinders, Welding Oxygen, Sept., 58.

D

Destroyer Takes a Bow, Aug., 45.
Die, Arc Welded, June, 58.
Directory, Welding Industry's, Mar., 53.
Distortion, Correcting in Large Structures, Feb., 34.
Distortion, Preventing in Large Structures, Jan. 40.
Drydocks: Giant's Elbow, May, 56.
Duplex Brazing Torch, Aug., 54.

E

Elbow, Giant's, May, 56.
Electrode, Copper-Saving, Nov., 64.
Electrodes, Refrigerated, Aug., 41.
Electrodes, Using Larger, May, 59.
Electronic Control of Gas Cutting Machines, Nov., 38; Dec., 49.
Electronic Controls, Types of, Feb., 42.
Electronic Tubes: Spaghetti Aids Welding, Oct., 81.
Electroplating: Worn Parts Made New, Apr., 33.
Ending Cutting Tool Absenteeism, Sept., 44.
Engineering Data Sheets: 28: Metals Preheating Chart, Jan., 57; 29: Is the Steel Beam Strong Enough? Feb., 71; 30: Trade Names of Electrodes and Comparable AWS Designations, Mar., 119; 31: Nema Welding Electrode Standards, Apr., 67; 32: Horizontal Tank Capacities, May, 63; 33: Fire Extinguisher Information, June, 74; 34: Tool Tipping Data, July, 61; 35: Temperature Conversion Tables, Aug., 35; 36: Welding Rod Specifications, Sept., 71; 37: National Emergency Steel Specifications Revised (1943) Oct., 79; 38: Hardness Conversion Table, Nov., 81; 39: Dec., 75.
Eyes, Weldor's—Let's Protect Them, July, 38.

F

Fabricating Marine Gears, May, 60.
Fabricating Big Gears, Sept., 61.
Facts and Figures, Mar., 39.
Feedwater Heater Welded, Dec., 70.
Feeding a Multitude, Aug., 52.
Field Maintenance Welding of Heavy Construction Equipment (Part I), Feb., 38.; Part II, Mar., 34; Part III, May, 44.
First and Last, Dec., 64.
Fixtures, Building Your Own, July, 49.
Flame-Cut Gear Blanks, Aug., 57.
Flame-Cutting: Bad News for Nazi Subs, Sept., 48.
Flame-Cutting: Bar-Cutting Simplified, Apr., 55.
Flame-Cutting Car Rails, Oct., 83.
Flame-Cutting: Cutting a Seven-Ton Slab, Sept., 56.
Flame-Cutting: Cutting Tank Sprockets, May, 59.
Flame-Cutting: Cutting Track Extension, Dec., 77.
Flame-Cutting Heavy Sections, Nov., 38.
Flame-Cutting: Segment Cutting, June, 54.
Flame-Hardening Big Rolls, May, 56.
Flame Hardening: The Hardening Flame—Part I, Jan., 31; Part II, Feb., 47; Part III, Mar., 96.
Flame-Hardening, Ordnance, Nov., 74.
Flash Welding, Applying to Airplane Construction, Nov., 46.
Flash Welding of Nickel, Nov., 39.
Flywheel, Repaired, Feb., 60.
Frame Repaired, Motor, Mar., 112.
Frames, Welded Motor, Feb., 60.
Fuel Economizer: "Impossible" Job, July, 52.
Fume Remover, Welded, Sept., 56.

G

Galvanized Steel, Shrinking, May, 40.
Gas Apparatus, L-268 Limits, Mar., 94.
Gas-Cutting Machines, Electronic Control of, Dec., 49; Nov., 38.
Gas Welding Copper Plate, July, 44.
Gear Blanks, Flame-Cut, Aug., 57.
Gears, Fabricating Big, Sept., 61.
Gears, Fabricating Marine, May, 60.
Giant's Elbow, May, 56.
Girder, Welded Tool Post, Sept., 40.
Guns Big and Little, Oct., 44.
Gun Carriage, Welded Bofors Anti-Aircraft, Jan., 36.

H

Hammered Resistance Welding, Apr., 36.
Hardening Flame, The (Part I), Jan., 31, Part II, Feb., 47; Part III, Mar., 96.
Hard-Facing Applications and Techniques (Part I), Sept., 31; Part II, Oct., 43.
Hard-Facing Railroad Bolts, Jan., 54.
Hard-Facing, Reclamation by, Nov., 51.
Hardness Tests, Weld-Bead, Nov., 39.
Health: Pass the Salt, July, 47.
Health: Weldor's Eyes—Let's Protect Them, July, 38.
Helium-Shielded Arc Welding, Oct., 66.
High Frequency Brazing, Feb., 60.
High Frequency Tool Brazing, July, 43.

I

IAA: Convention in Chicago, Oct., 49.
IAA Luncheon Meeting, Nov., 37.
Ignitrons Seam Welded, June, 50.
"Impossible" Job, July, 52.
Incandescent Brazing, May, 59.
Induction Coils, Articulated, Dec., 60.
Induction Heating Cuts Time, Oct., 68.
Induction Heating—A New Tool, Apr., 39.
Inspection of Pressure Vessels and Piping, Nov., 76.
Inspection of Welds, Magnetic, Aug., 31.
Installation: Feedwater Heater Welded, Dec., 74.

J

Jail, Welding Goes to, Nov., 70.
Jigs: Building Your Own Fixtures, July, 49.

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L

L-268 Limits Gas Apparatus, Mar., 94.
Large Welded Valves, June, 46.
Lathe, Weldor "Stretches" a, Jan., 35.
Let Us Not Go Backwards, Feb., 58.
Light for Welding, Better, Nov., 56.
Light Guides Welding, Nov., 70.
Locomotive Parts Fabricated, Nov., 38.
Locomotive Repairs, Arc Welded, Feb., 42.
Lubrication: Welded-In Drip Pan, Nov., 72.

M

Machine-Cutting for Assembly Line Fabrication, Nov., 38.
Magnesium Alloys, Arc Welding—Part II, Jan., 46.
Magnetic Inspection of Welds, Aug., 31.
Magnetism: Weld Big Gratings, Dec., 81.
Maintenance, For, Oct., 48.
Maintenance Welding of Heavy Construction Equipment, Field (Part I), Feb., 38; Part II, Mar., 34; Part III, May, 44.
Making Big Plates, Aug., 57.
Making Wire Rope Safer, Mar., 108.
Masks; Voodooing the Axis, Sept., 39.
Metal Cab Protection, Aug., 53.
Metallizing: Worn Parts Made New, Apr., 33.
Metallizing for Profit, June, 34.
Mobile Warfare, For, Oct., 42.
Monel Metal: Welded Chains Boost Steel Output, Dec., 68.
Motor Frame Repaired, Mar., 112.
Motors, Ten Commandments for, Nov., 72.
Mud Scraper, June, 56.
Music and War Work, Oct., 76.
National Metal Congress, Oct., 62.
NE Steel Substitutes, New, Nov., 62.
New A-C Welding Circuit, Sept., 52.
Nickel, Flash Welding of, Nov., 39.
1942—A Hectic Welding Year, Jan., 27.
Normalizing on Welder, Sept., 58.

O

Ordnance Flame-Hardening, Nov., 74.

P

Patrol Vessels: U-Boat's Foe, June, 50.
Peening: Let Us Not Go Backwards, Feb., 58.
Personnel: Blind War Workers, Dec., 76.
Pipe Crossover, June, 58.
Pipe Line (Big Inch): First and Last, Dec., 64.
Pipe & Rod Carrier, Aug., 57.
Pipe, Welding Big, Sept., 61.
Piping, Inspection of Pressure Vessels and, Nov., 76.
Piping: Welding Weathers Storm, Aug., 54.
Plate Cutting Shears, June, 58.
Plates, Making Big, Aug., 57.
Positioning Bonnets, July, 56.
Preheating Avoids Cracks, Sept., 54.
Preheating Torch, July, 54.
Pressure Vessels: Blind Date with a Convoy, Oct., 68.
Pressure Vessels: Buffer Bars for Boiler, Oct. 70.
Pressure Vessels and Piping, Inspection of, Nov., 76.
Preventing Distortion in Large Structures, Jan., 40.
Rails, Flame-Cutting Car, Oct., 83.
Reclaiming Propellers, Mar., 110.
Reclamation by Hard-Facing, Nov., 51
Reclamation of Perishable Tools, Nov., 78.
Recorder, Why the Weld? Nov., 39.
Refineries on Stilts, Apr., 55.
Refinery Fire Thwarted, Aug., 58.
Refrigerated Electrodes, Aug., 41.
Repaired, Flywheel, Feb., 60.
Repaired, Motor Frame, Mar., 112.
Repairs, Arc Welded Locomotive, Feb., 42.
Resistance Welding Developments and Operations, Unusual, Jan., 44.
Resistance Welding, Hammered, Apr., 36.
Resistance Welding: Ignitrons Seam Welded, June, 50.
Resistance Welding: Underwater, Apr., 56.
Resistance Welding: Welded Fintubes, June, 52.
Riveting with a Welder, Oct., 76.
Rope, Making Safer, Wire, Mar., 108.

S

Safer, Making Wire Rope, Mar., 108.
Safety: Metal Cab Protection, Aug., 53.
Safety: Welding Fume Remover, Sept., 56.
Safety: Weldor's Eyes—Let's Protect Them, July, 38.
Salvaged, Aluminum Castings, Aug., 52.
Salvage: Destroyer Takes a Bow, Aug., 45.
Salvage: Reclamation by Hard-Facing, Nov., 51.
Salvage: Refinery Fire Thwarted, Aug., 58.
Salvage: Snow Bucket from Scrap, Dec., 70.
Salvage by Welding, Tool, May, 35.
Salvaging Cylinder Heads, July, 59.
Salvaging Tungsten Steel, Mar., 108.
Saving a Steam Turbine, May, 62.
Silver Alloy Brazing, Aug., 47.
Schenectady Sank, Why the, Apr., 42.
Seamless Tubing Manufacture, Mar., 108.
Segment Cutting, June, 54.
Shipbuilding, Control of Welding in, Nov., 74.
Ships: For The Sea War, Oct., 40.
Ships: Reclaiming Propellers, Mar., 110.
Ships: Showcases to Ship Ventilators, Oct., 72.
Ships: Welded Fintubes, June, 52.
Ships: Welded Ships Can Take It, Feb., 46.
Shipyard Welding and Cutting, Nov., 39.
Shop Welding, Agricultural, May, 41.
Shop Welding: Welding in Brazil, Oct., 66.
Shrinking Galvanized Steel, May, 40.
Silver Alloy Brazing, Aug., 47
Silver Brazing Tongs, Mar., 114.
Snow Bucket from Scrap, Dec., 70.
Some of the Industry's Leaders Say, Jan., 30.
Spaghetti Aids Welding, Oct., 81.
Spot Weld Joint Efficiency for Aluminum Alloys Nov., 78.
Spot Weld Tester, July, 52.
Spot Welded Superchargers, Nov., 66.
Spot Welded Switchgear, Jan., 54.
Spot Welding, Aircraft, Nov., 78.
Spot Welding Faults, Aluminum, Mar., 31.
Spot Welding Heavy Gauge Steel, Nov., 39.
Spot Welding Thermostats, June, 54.
Spot Welding Variables, Sept., 34.
Stainless-Clad Bubble Tower, Oct., 118.
Stand: Flame-Cut Press, Nov., 70.
Steel, Winning with Welded, Oct., 52.
Stored Energy Welding of Mild Steel, Nov., 39.
Stress Relieving Weldments, June, 72.
Structure: Argentine Welding Job., Dec., 71.
Structures, Correcting Distortion in Large, Feb., 34.
Structures, Preventing Distortion in Large, Jan., 40.
Stud Welding Collet, July, 56.
Switchgear, Spot Welded, Jan., 54.

T

Tank, Unique Fuel, Dec., 72.
Tanks: Crushed, But Not Leaking, Apr., 55.
Tanks: For the Ground War, Oct., 38.
Tanks: Tear Drops for Tojo, July, 33.
Tear Drops for Tojo, July, 33.
Tensile Testing Machine, Sept., 61.
Tester, Spot Weld, July, 52.
Testing Machine, Tensile, Sept., 61.
Thermostats, Spot Welded, June, 54.
Tip, Victory Heating, Jan., 54.
Tipped Tools, Brazing, Apr., 52.
Tips, Cleaning Torch, Apr., 52.
Tongs, Silver Brazing, Mar., 114.
Tool Demagnetization, Dec., 70.
Tool Post Girder, Welded, Sept., 40.
Tool Rack, Revolving, Nov., 64.
Tool Salvage by Welding, May, 35.
Tools, Reclamation of Perishable, Nov., 78.
Torch, Cleaning Method, June, 50.
Torch, Duplex Brazing, Aug. 54.
Track Roller Frame Assembly: WPB Award, May, 60.
Trailer, Australian Welded, Dec., 66.
Training for War Industries, June, 38.
Training School, Shipfitting, Dec., 43.
Training Soldiers to Weld, Apr., 32.
Training, Welding Operator, Nov., 76.
Tubing Manufacture, Seamless, Mar., 108.
Tubing, Welded Heat Exchanger, Dec., 52.
Tubular Structures, Welding, June, 31.
Tungsten Steel, Salvaging, Mar., 108.
Turbine, Saving a Steam, May, 62.
Turbine Speed Ring, Brazing a 7,100 Hp (Part I), Apr., 29; Part II, May, 48.

U

U-Boat's Foe, June, 50.
Underwater Welding, Apr., 56.
Unique Fuel Tank, Dec., 72.

V

Valve, Brazing a Broken Gate, Sept., 42.
Valves, Large Welded, June, 46.
Ventilators, Showcases to Ship, Oct., 72.
Victory Heating Tip, Jan., 54.
Voodooing the Axis, Sept., 39.

W

War, Welding at, Oct., 35.
Warfare; For the Air War, Oct., 36; For the Ground War, Oct., 38; For the Sea War, Oct., 40; For Mobile Warfare, Oct., 42; Guns Big and Little, Oct., 44; Amphibians for Landings, Oct., 46; For Maintenance, Oct., 48.
Weapons for Victory, Welding, Feb., 31.
Welded Air Raid Whistle, Apr., 52.
Welded Boiler Stacks, July, 52.
Welded Chains Boost Steel Output, Dec., 68.
Welded Composite Tools, June, 40.
Welded Fintubes, June, 52.
Welded Motor Frames, Feb., 60.
Welded Musical Instruments, Sept., 56.
Welded Tool Post Grinder, Sept., 40.
Welded Tubular Fuselages, May, 38.
Welder, Battery Charger to, July, 66.
Welding Bell Airacobras, Aug., 37.
Welding Big Pipe, Sept., 61.
Welded Bofors Anti-Aircraft Gun Carriage, Jan., 36.
Welding at War, Mar., 112.
Welding at War, Oct., 35.
Welding for Civic Maintenance, July, 46.
Welding Fume Remover, Sept., 56.
Welding Industry's Directory, Mar., 53.
Welding Oxygen Cylinders, Sept., 58.
Welding Tubular Structures, June, 31.
Welding Weapons for Victory, Feb., 31.
Welding Weathers Storm, Aug., 54.
Welding Well Casings, Mar., 114.
Weldor's Eyes—Let's Protect Them, July, 38.
Weldor "Stretches" a Lathe, Jan., 35.
Whistle, Welded Air Raid, Apr., 52.
Why I Am A Weldor, July, 37.
Why Not a Welding Clinic?, Mar., 38.
Why the Schenectady Sank, Apr., 42.
Winning with Welded Steel, Oct., 52.
Women: Champion Woman Weldor, July, 48.
Women: Handy with a Welding Torch, June, 33.
Women Weldors, Apr., 55.
Worn Parts Made New, Apr., 33.
WPB Award, May, 60.

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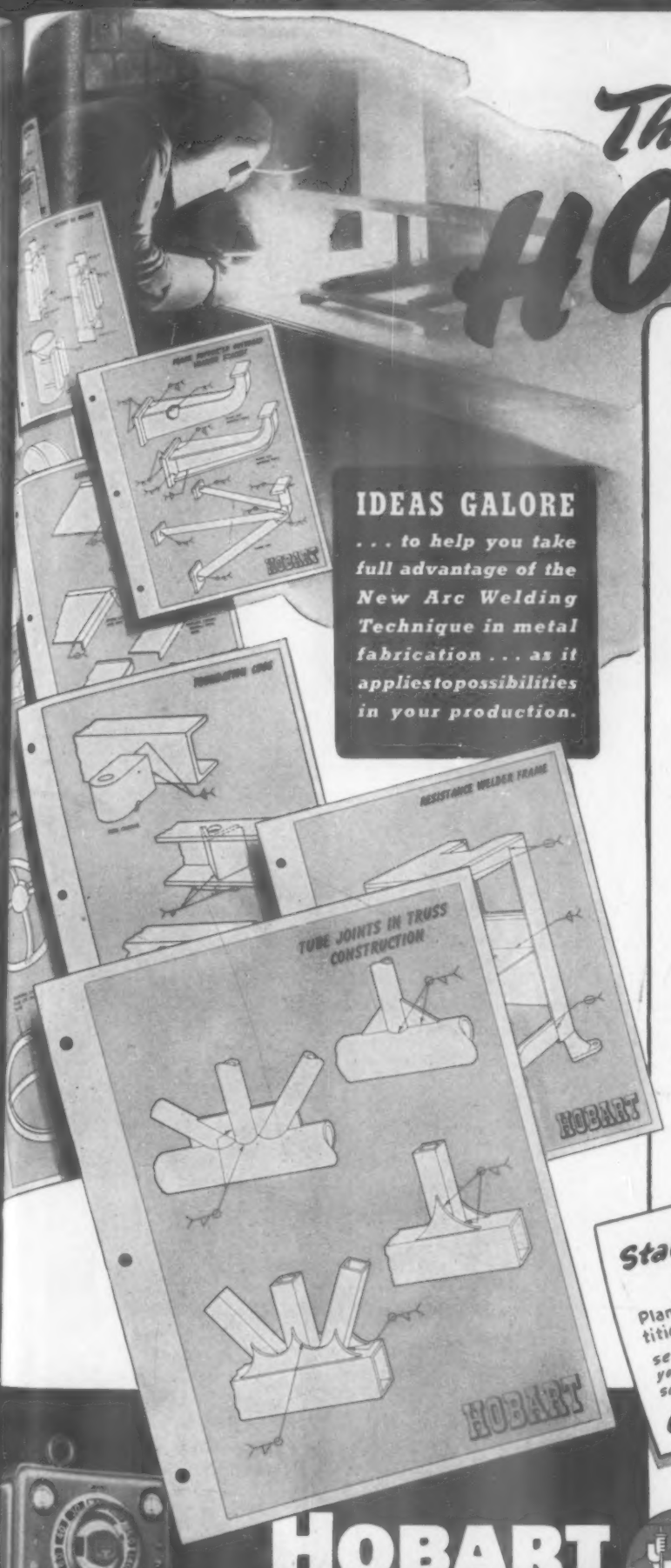

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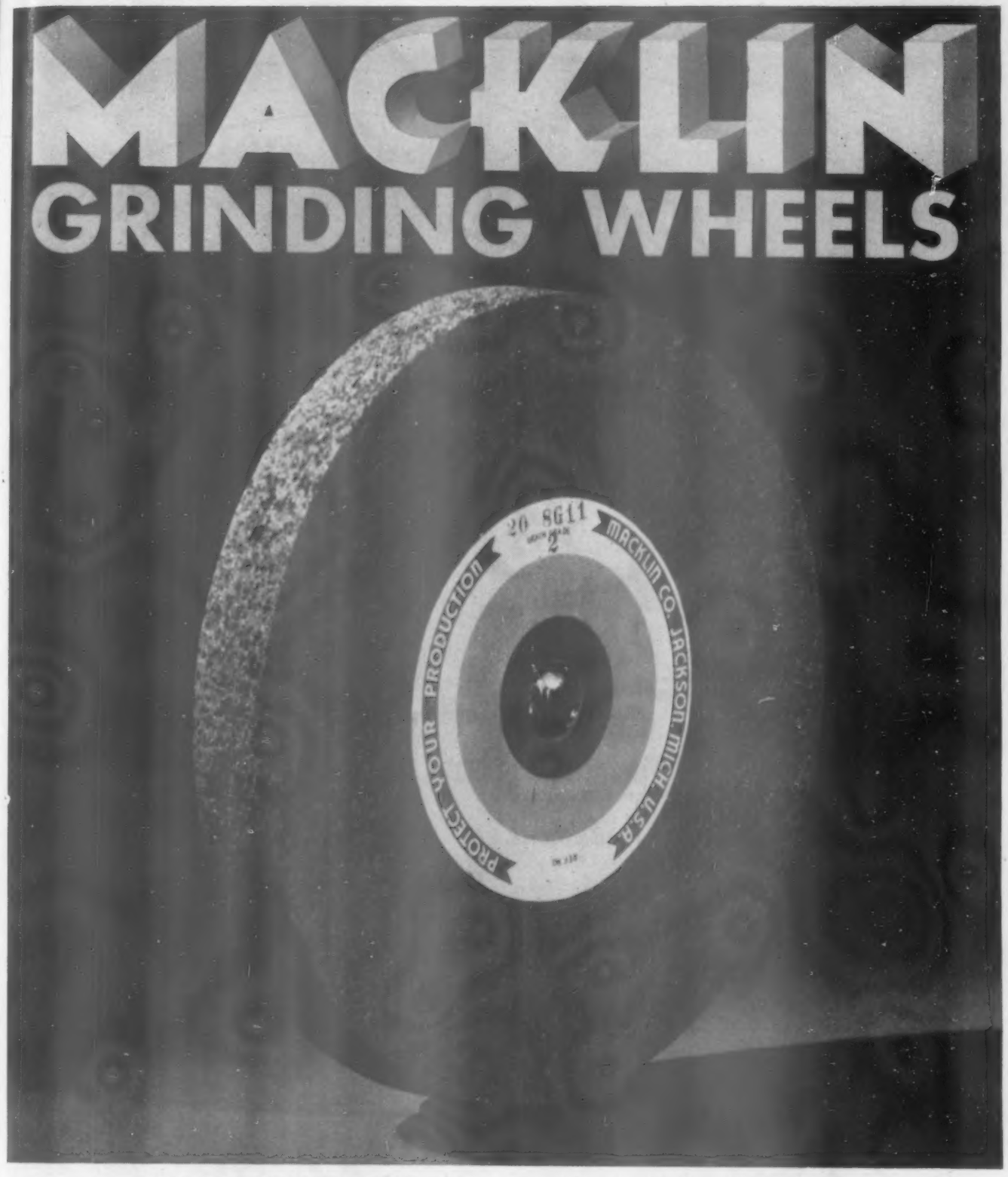

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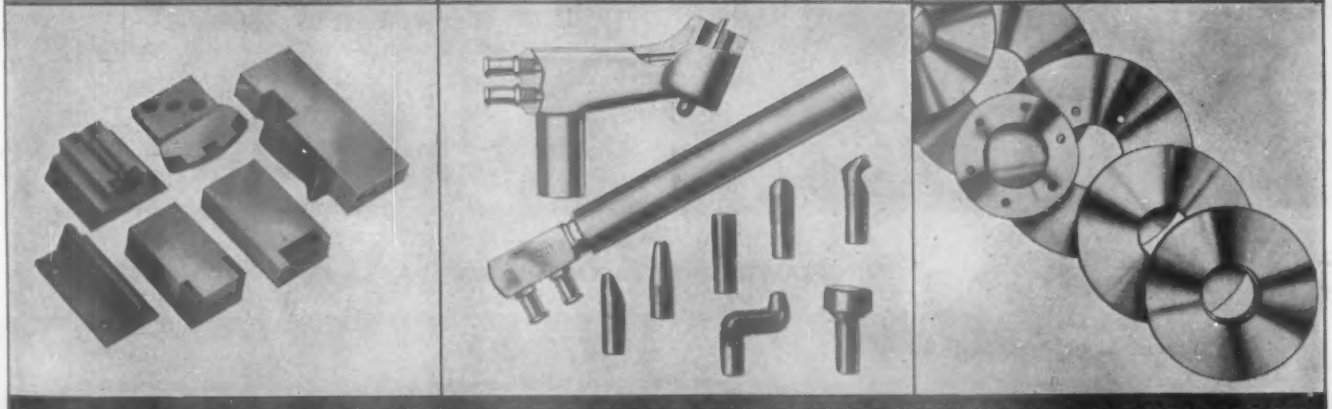

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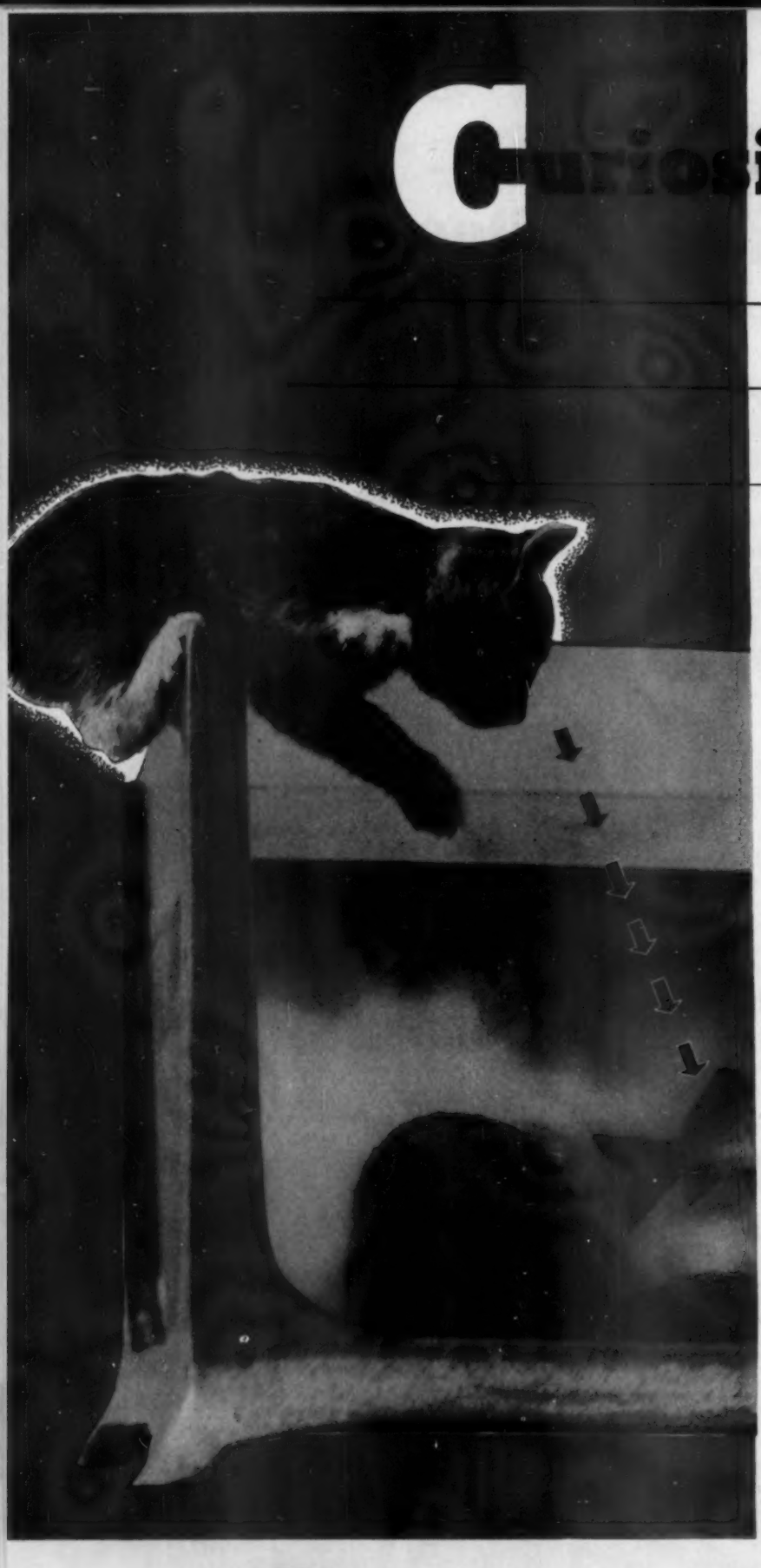

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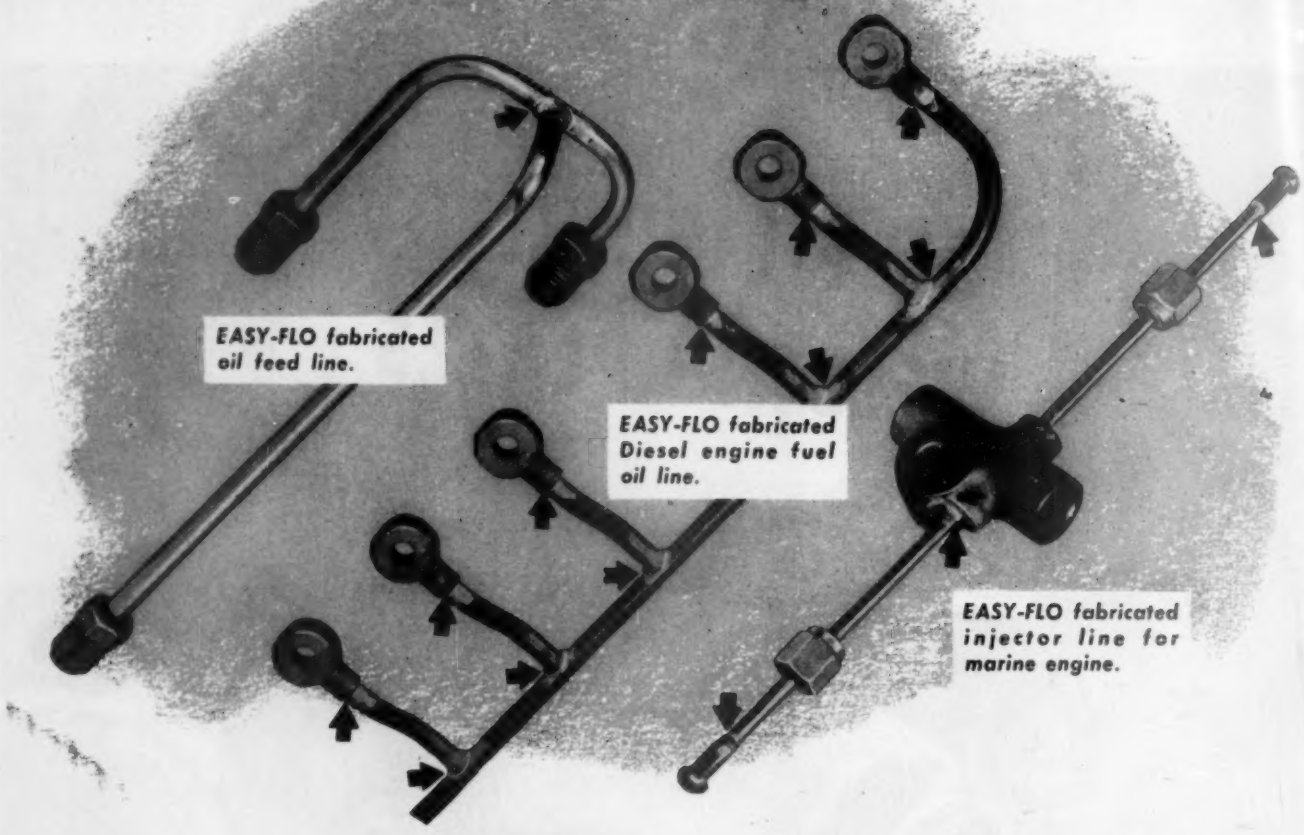
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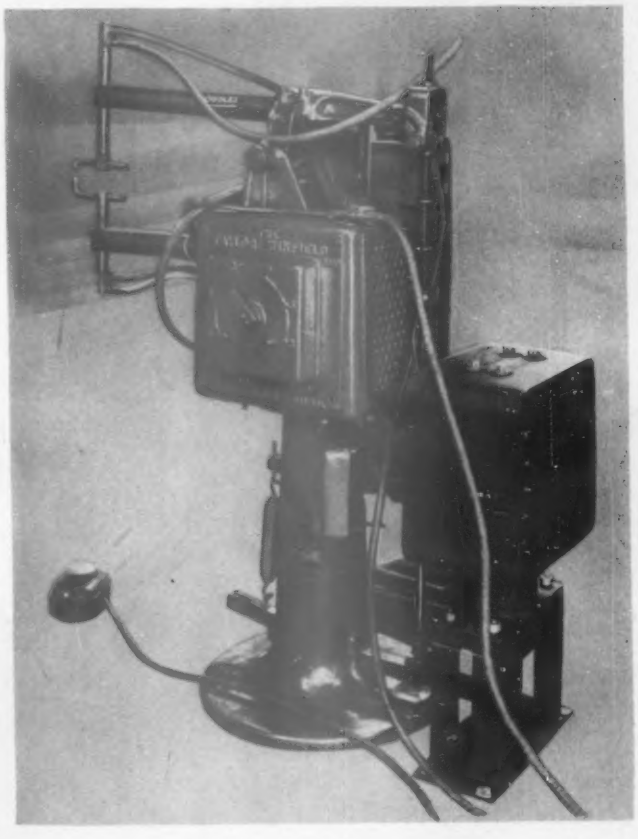

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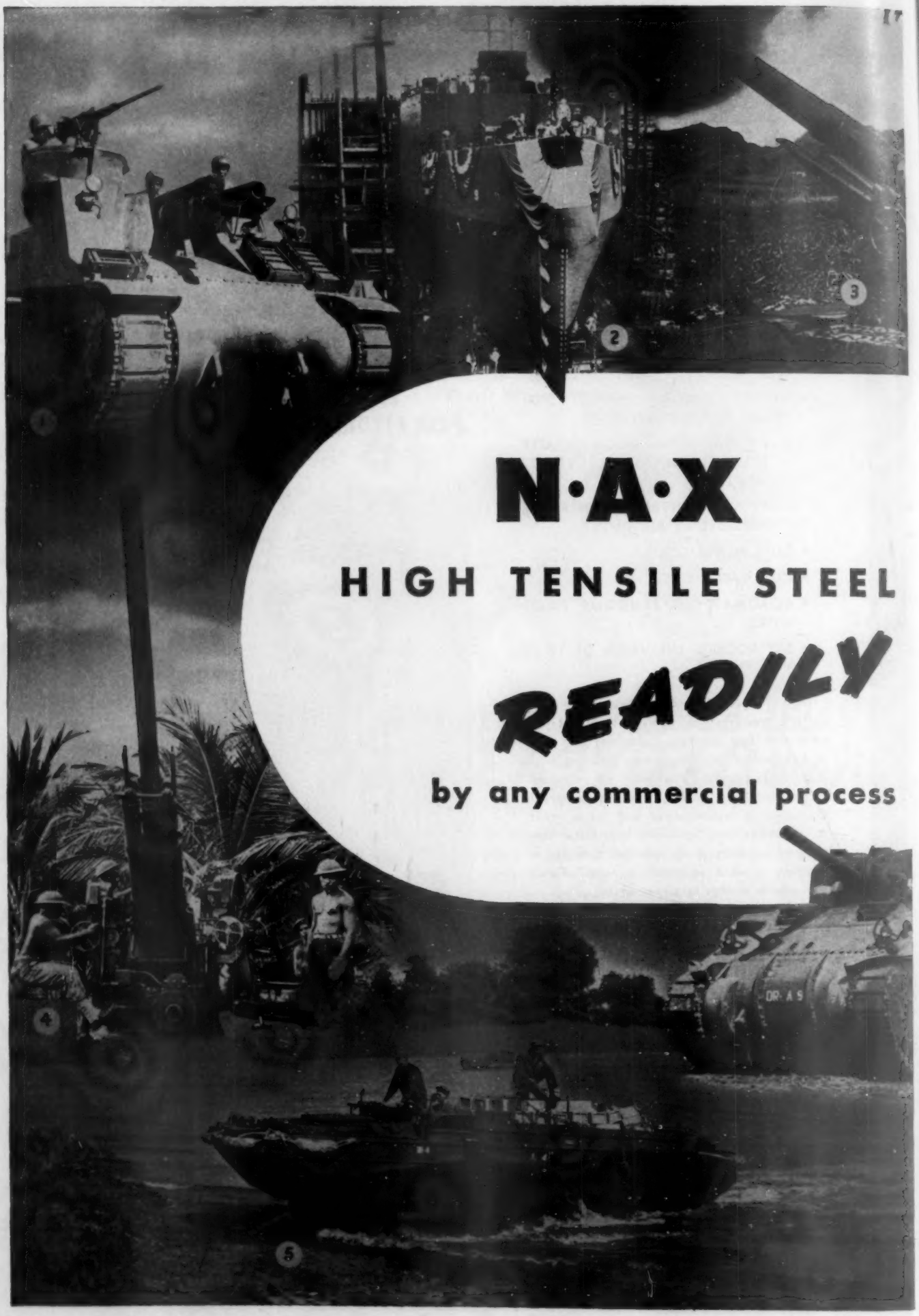

N·A·X
HIGH TENSILE STEEL
READILY
by any commercial process

DUCTILITY
ITS INHERENTLY FINER GRAIN MAKES ALL THE DIFFERENCE
STRENGTH

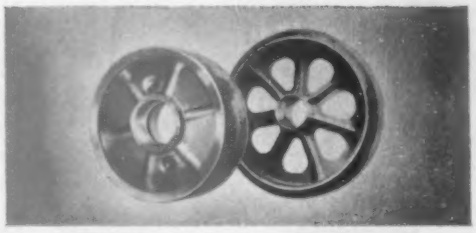
Adaptability is the word for N-A-X HIGH TENSILE STEEL. With *high* ductility, *high* yield point and *high* ultimate strength—*great* resistance to fatigue and impact even at sub-zero temperatures—*marked* resistance to abrasion and corrosion and *excellent* welding qualities, this modern metal provides a timely answer to a wide variety of service and fabricating problems.

WELDED...

N-A-X HIGH TENSILE STEEL can be easily and speedily welded by any of the commercial methods with the assurance of getting *strong,* reasonably ductile weldments. N-A-X HIGH TENSILE STEEL is ideal for arc, spot or resistance welding. It fuses and mixes readily with the weld metal and does not air harden. Write for our new book on N-A-X HIGH TENSILE and 9100 SERIES STEELS. It gives you complete welding details and other specifications helpful in adapting these versatile steels to your own needs . . . and remember that our own competent technical staff, familiar with all phases of welding, is always available for consultation.

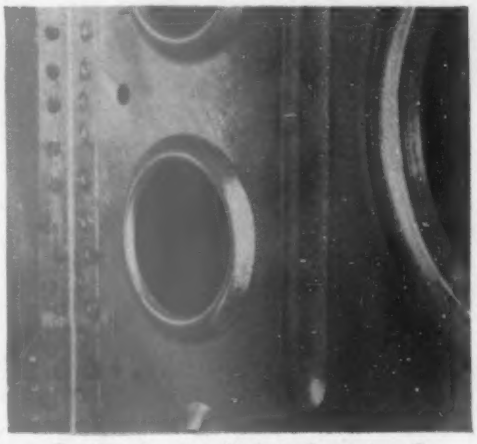
PICTURES 1, 3, 4, 5 & 6 WERE TAKEN BY THE UNITED STATES SIGNAL CORPS. NUMBER 2 IS AN OFFICIAL U. S. NAVY PHOTOGRAPH

A FEW EXAMPLES

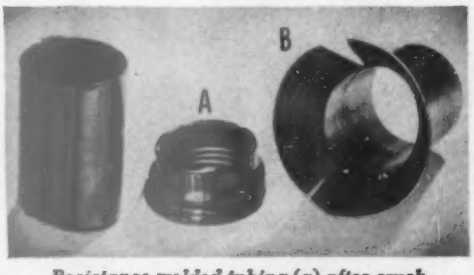


Electric arc welded tank wheels of N-A-X HIGH TENSILE STEEL

Air Corps Oxygen tanks, welded by the atomic hydrogen arc method on fully automatic equipment



Section of spot welded airplane wing rib of N-A-X HIGH TENSILE STEEL



Resistance welded tubing (a) after crush test, (b) after swedge burst test

GREAT LAKES STEEL CORPORATION

DETROIT, MICHIGAN—*Sales Offices in Principal Cities*

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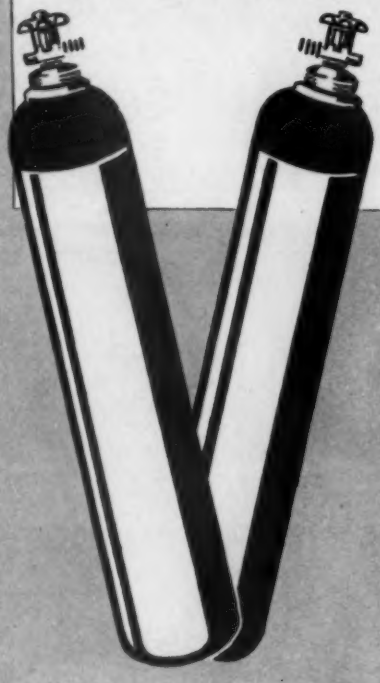
Independent Engineering Co.

CYLINDERS *and* Cylinder Transports

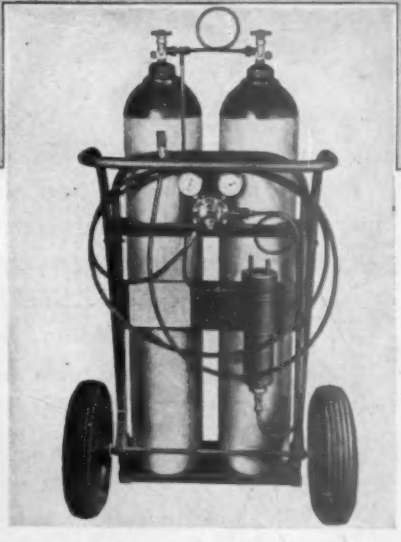
For the Armed Service Until

ICTORY Is Won



All shipments of Independent Engineering Co. Cylinders are under complete control of the armed forces except where adequate priority, otherwise, is available. We are proud of the outstanding record we have achieved in meeting their requirements. When peace comes, these achievements in pioneer engineering design, construction and production will be at the disposal of all—a record that will make Independent Engineering Co. products a *first* thought when industrial gas producing, packaging and transporting equipment are under consideration.

Mammoth Cylinder-Transports, built by Independent Engineering Co., (as illustrated below) make possible the efficient, economical delivery of large quantities of industrial gases in a single unit to any given point with a minimum of delay . . . a valuable contribution to the Service of Supply.



Thousands of Independent Engineering Co. Rechargers now serve the war cause and those who serve the war effort. The final step in the Service of Supply—these—flexible, easy-to-handle units are used to distribute cylinders to the point of usage.

Independent Engineering Co.—Pioneer designers and producers of mobile Oxygen and Hydrogen generating plants for the armed forces...builders of Oxygen, Hydrogen and Acetylene plants — manufacturers of industrial gas cylinders and cylinder handling equipment.

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ATLAS TOMAHAWK

Model Number 3

Featuring ENDURO Hardene Heads; Chipping Faces at righ angles to each other. Wooden Han Grip.

Available in 12 or 16 ounce weight

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for welder identification

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DUAL-TOOL MODEL B

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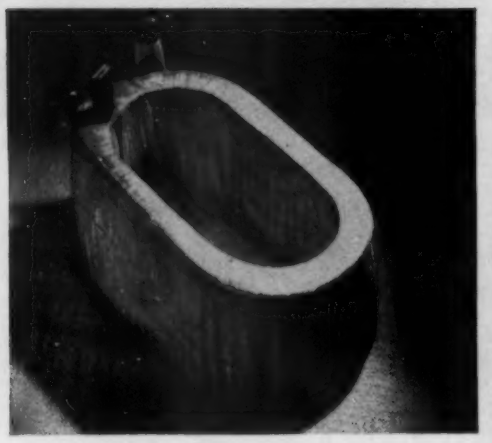
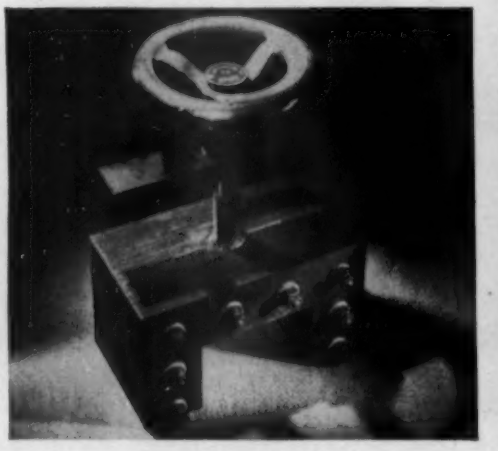
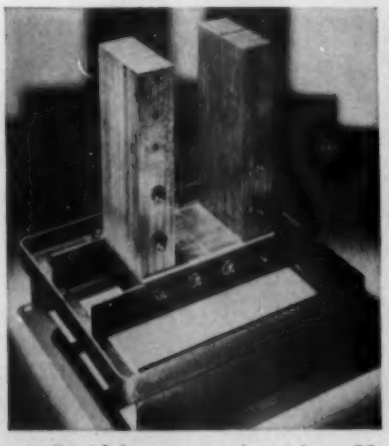


1 Reactor coil on Ampac a-c welder is compact, cool-operating. Oversize winding *dissipates* heat — *increases* efficiency. Spun-glass insulation is flame-proof!



2 Upper core moves only 1 inch . . . covering entire 50-500 amp welding range in *seven easy turns* of control wheel. *Cuts* welding time — *speeds* output!

3 Here's a-c welding at its newest and finest! Note simple design — rugged construction. Integrated reactor-transformer circuit provides noiseless, trouble-free operation . . . with minimum idling loss. Ampac gives you *all* a-c welding advantages — including *no arc blow!*



4 Rigid lower core is 1-piece, U-shaped . . . of die-punched silicon steel. *No* air gaps to waste valuable power!

5 Typical of Ampac's quality design is this big, tough welding terminal. Note permanent connections are *brazed!*

A 1666

GET COMPLETE FACTS on Ampac . . . learn how its patented circuit cuts costs — increases production. Call on your nearby Ampac dealer or write for bulletin B6302. Also ask for B6241 on Ampac "200".

ALLIS-CHALMERS

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Short, short story

Using only 18 pounds of Anaconda "997" Low Fuming Welding Rod, the Hebeler Welding Co. of Buffalo, New York, repair-welded this eccentric housing for the Ushco Mfg. Co., Inc., in less than 20 man-hours.

Important war production plant...
Eccentric housing breaks on drop forge hammer...
Welded with Anaconda "997" Low Fuming...
Hammer back on job next day!

That's the way low-temperature Bronze welding is helping out in emergencies these busy days. A broken 2½-ton gear was returned to service in less than a week; a seven-foot fracture in a 6-ton press column was repaired in three days; a fractured 2-ton section of a 100" boring mill was repair-welded in 39 hours.

And so it goes—in every branch of industry, on every type of equipment—on parts made of cast iron, steel, malleable iron and copper alloys.

Keep in mind this modern method of salvaging costly machine tools, production parts and equipment—at a fraction of the cost of new replacement parts. Keep in mind also that Tobin Bronze*, "997" Low Fuming and other Anaconda Welding Rods are preferred by many industrial shops for making dense, high strength, Bronze welding repairs.

*Reg. U. S. Pat. Off. 4970

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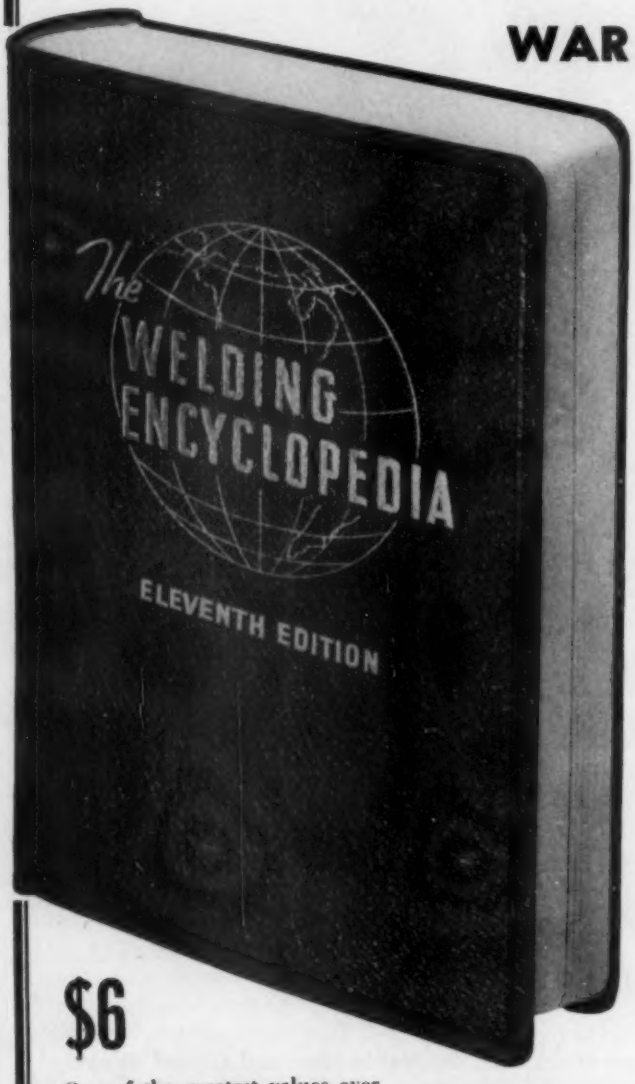
ANACONDA

Anaconda Welding Rods

INDISPENSABLE • COMPLETE • UP-TO-DATE INFORMATION ON WELDING!



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NOW - NEW

THE 11th EDITION of The WELDING ENCYCLOPEDIA

Metals that can be Hard-Faced to make wearing parts last longer

Hard-facing is of particular importance today because when vital parts that are subjected to wear are hard-faced with rods made by Haynes Stellite Company, they last from 2 to 25 times longer. This helps to keep essential machines and equipment in service, and eliminates the needless scrapping of parts, excessive down time, and delays in production. Usually the amount of hard-facing material required is only a small percentage by weight or volume of the part to be protected.

Most of the commonly used metals can be hard-faced successfully. The following classification affords a means of determining what metals or alloys can or cannot be hard-faced, and by what method.* For more information, write for the booklet, "Hard-Facing With Haynes Stellite Products."

Carbon Steels (plain carbon steels up to 0.60 per cent carbon) — These can be hard-faced successfully either with the oxy-acetylene* or the metallic-arc process.

High-Carbon Steels (steels with carbon above 0.60 per cent)—Proper heat-treatment both before and after hard-facing, by either process,* is advisable to prevent failure of the base metal because of its hardness and brittleness.

Low-Alloy Steels—These can be hard-faced in much the same manner as plain carbon steels, but in some cases heat-treatment is required after welding.

High-Speed Steel—The hard-facing of this group of steels is not recommended. They can be hard-faced without any trouble in so far as technique is concerned, but shrinkage cracks and strain checks frequently render the hard-faced piece valuless, regardless of heat-treatment.

Manganese Steel—Can be hard-faced successfully, using the metallic arc process.

Stainless Steels (18-8 chromium-nickel steels)—These steels can be readily hard-faced by either the oxy-acetylene process* or the metallic arc process. In some instances, heat-treating is required.

Straight-Chromium Steels (4-6 and 11-13 per cent chromium steels)—Can be hard-faced by either process.* To avoid cracking of the deposit, the part must be preheated almost to a red heat and cooled slowly, preferably in a furnace.

Cast-Iron—Cast Iron can be hard-faced by either process.* The procedure is different from that of steel because of the lower melting point of cast iron.

Chilled Iron—Small parts can be hard-faced with either the oxy-acetylene* or metallic arc process. On large parts difficulty is usually encountered.

Alloy Cast Iron—The procedure for hard-facing this material is the same as for ordinary gray cast iron.

Monel—Monel is easily hard-faced with the oxy-acetylene process.

Brass and Bronze—Because of their low melting points, these alloys cannot generally be hard-faced.

Copper — Because of its low melting point and high heat conductivity, it is best to use the metallic arc for hard-facing copper, preheating to a red heat.

Aluminum — Aluminum or its alloys cannot be hard-faced.

*For the majority of hard-facing applications, the oxy-acetylene process is generally used. The blowpipe allows close control over the operation and produces a smooth deposit. Particles of scale and foreign matter can easily be eliminated, and edges and corners can readily be formed. Other advantages include the elimination of rod loss due to vaporization or spattering, and accurate control over the degree of penetration.

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HAYNES STELLITE COMPANY

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HARD-FACING RODS FOR EVERY PURPOSE

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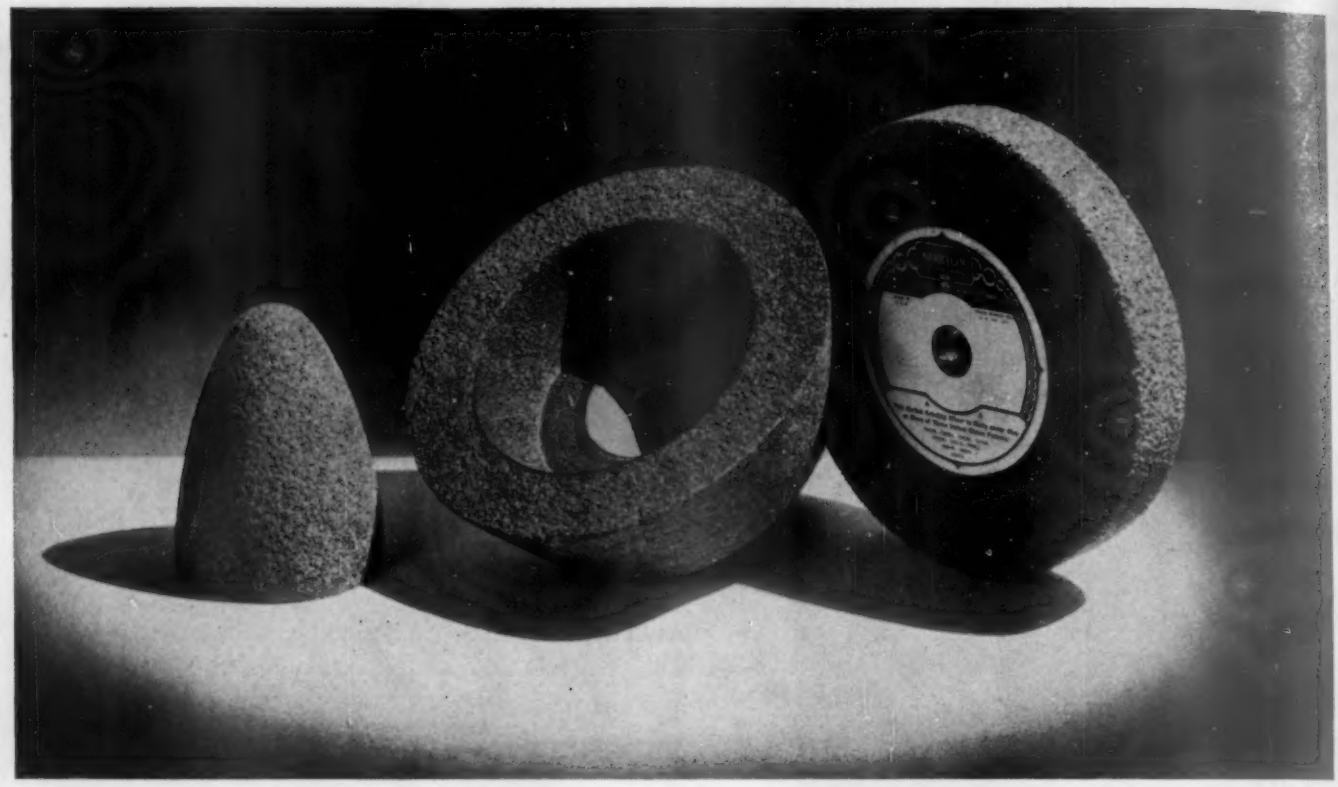

These Wheels Can Speed Your Weld Grinding Jobs

YOU need fast cutting action to quickly remove the excess metal at the weld—you need a smooth surface for the subsequent finishing operations. Norton Grinding Wheels have been scientifically developed to provide both and they are available in the right grains and grades for all kinds of weld grinding.

STRAIGHT WHEELS—Usually 6" or 8" diameter and from ¼" to 2" thick. For the thinner wheels 20 grain and a coarser grit—24—for the thicker wheels. The most common hardness is P4T or Q4T-H Alundum resinoid for carbon and alloy steels.

CUP WHEELS—Probably the most popular sizes are flaring cups (6-4½") x 2" x ⅝" with a 1" rim and straight cups 6" x 1½" x ⅝" with a 2" rim. They are available with ⅝" holes or mounted on ⅝" threaded steel bushings. For general work, the wheel specification is usually 16 or 20 grit, grade P4T Alundum resinoid.

CONE WHEELS—Cone wheels are mostly used for grinding welds in holes and other hard-to-get-at places. One of the most common sizes is 2¾" x 3½" with ⅝" threaded hole, 24 grit Q4T-L Alundum resinoid.

A booklet on Norton Wheels for portable grinders will be sent on request. Ask for Form 1328-WE.

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NORTON ABRASIVES

REPORTING *on the use of*

Linde Methods

in mass production..

METAL FABRICATING · · · *if you work with metals, you should know more about these Linde Methods for* "Carpentry in Steel."

In this picture, a Unionmelt electric welding machine is joining automatically the edges of steel plate being fabricated into a pressure vessel . . . making uniformly strong welds . . . at high speed. Other Unionmelt machines . . . mounted on light, overhead cranes . . . are working on semi-finished structures further down the line.

Unionmelt welding was developed by The Linde Air Products Company. Other Linde methods . . . the "flame" methods . . . are also important to the complete picture of joining metals. Oxy-acetylene steel welding, bronze-welding, copper welding, pressure-welding, silver brazing, and other joining techniques . . . whether manually applied or mechanized . . . all have a place in the mass construction of equipment of many sizes and kinds.

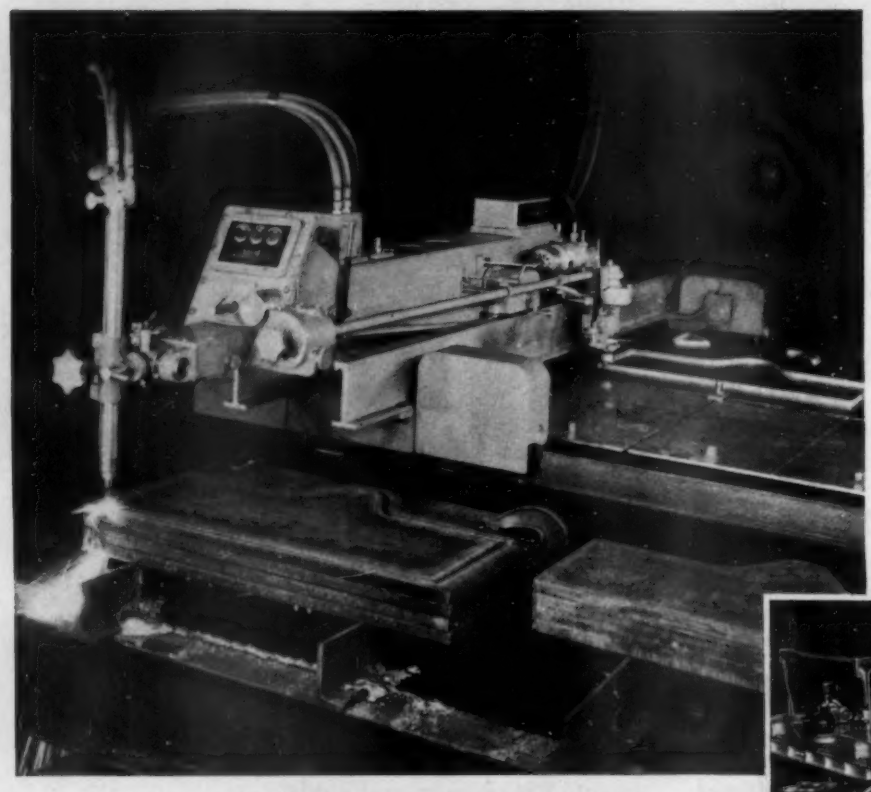
Mass production is truly a job of "carpentry in steel." Metals must be cut to size and shape . . . bent . . . formed . . . treated . . . for final fabrication. In all of these operations, Linde-developed flame processes are importantly employed.

Some applications of these flame processes are shown in the following pages. Review of them suggests the importance of keeping posted on *all* of Linde's advances in oxy-acetylene flame-fabrication . . . and of using productively, without waste, all supplies for these efficient metalworking methods.

In the Fabrication of STEEL EQUIPMENT

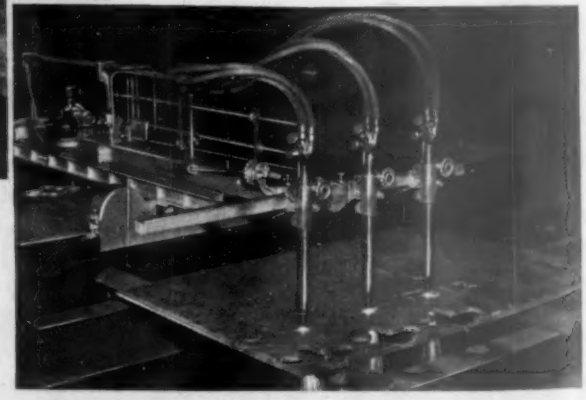
Linde Methods save Time, Power, and Materials . . .

A large part of the specialized mass production work of today is done faster, better, and at less cost by oxy-acetylene flame-techniques such as those shown here. The engineering facilities of The Linde Air Products Company helped industry to adapt these peacetime developments in efficient metalworking for today's needs. This quick review will help you to remember them . . . for tomorrow.

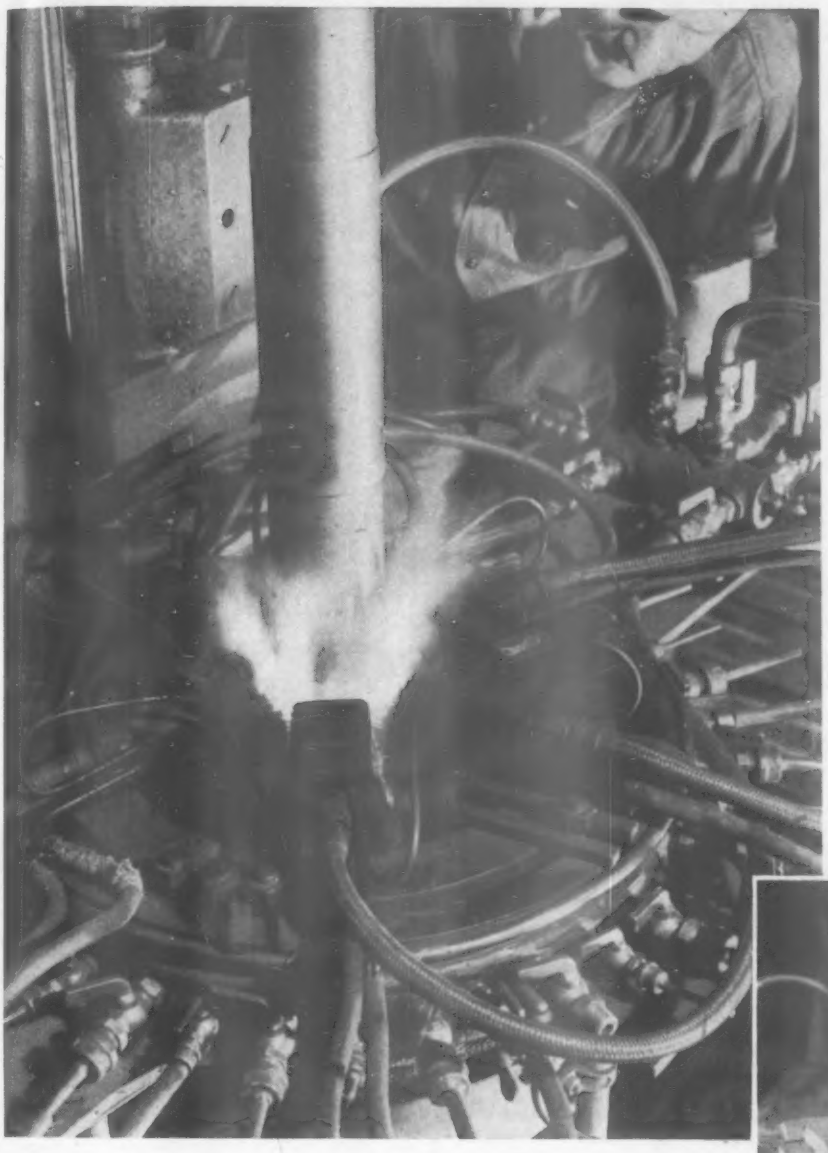


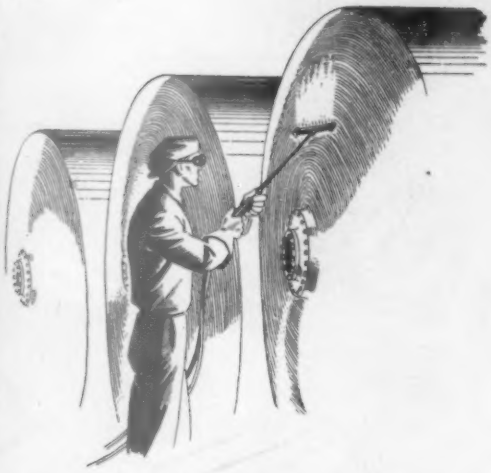
Oxy-Acetylene Flame-Cutting is a quick, "one-pass" method for shaping steel . . . in straight lines, circles, or irregular contours. Flame-cut edges are clean and smooth . . . often require no machining before use. Flame-cutting is done both with manually operated blowpipes, and with stationary or portable cutting machines. By flame-cutting, one-of-a-kind orders are easy to make up . . . design changes are simplified . . . and change-overs from parts of one shape to another require only a few minutes. In the illustration above, an Oxweld flame-cutting machine is "stack-cutting" four parts simultaneously. Shown at the right are other applications of flame-cutting.

Bending (above) — Oxy-acetylene flames provide intense, controlled heat for bending operations. Above, a pipe is being "wrinkle-bent" to produce a smooth, long-sweep turn without internal obstruction to flow.



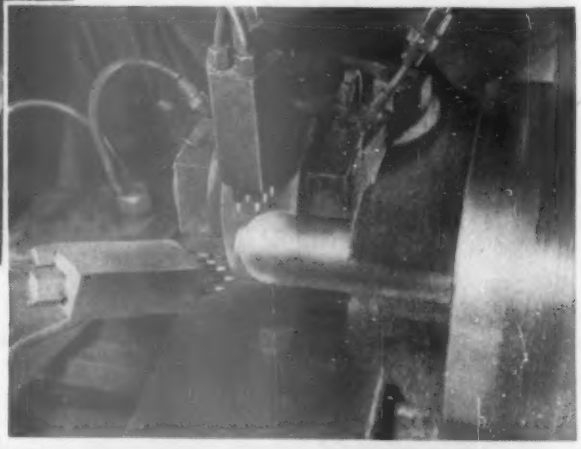
Multiple-Cutting—In some cases, when it is desired to produce numerous identical parts, several blowpipes . . . guided by a single templet . . . are mounted on the flame-cutting machine to cut simultaneously.



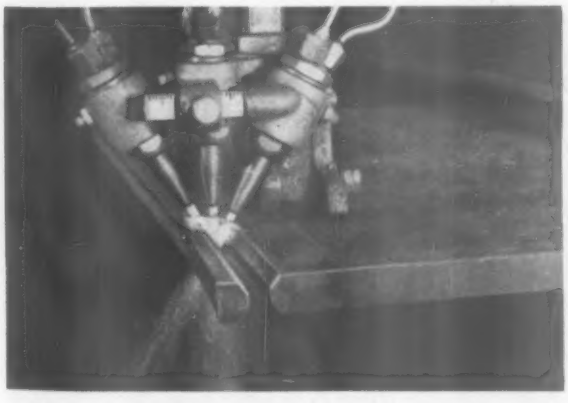


Flame-Priming (above)—Oxy-acetylene flame-priming of steel prior to painting removes loose scale, rust, moisture, oil, and grease. Paint applied to the still-warm surface bonds tighter and dries faster.

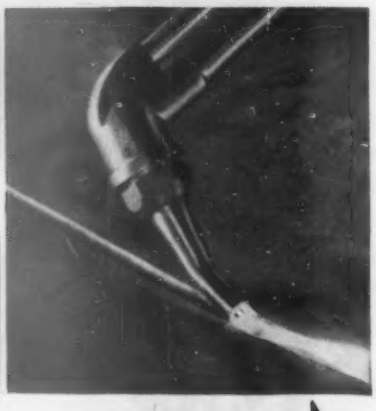
Flame-Spinning (below) — This flame-method for forming steel is used for such work as end-closure of tubing to eliminate deep-drawing operations.



Flame-Hardening (above)—Oxy-acetylene flame-hardening imparts a hard case to steel and iron parts without affecting the toughness of the core. Parts can thus be made of less costly base metals selected for core properties, and then protected against wear by flame-hardening surface areas.

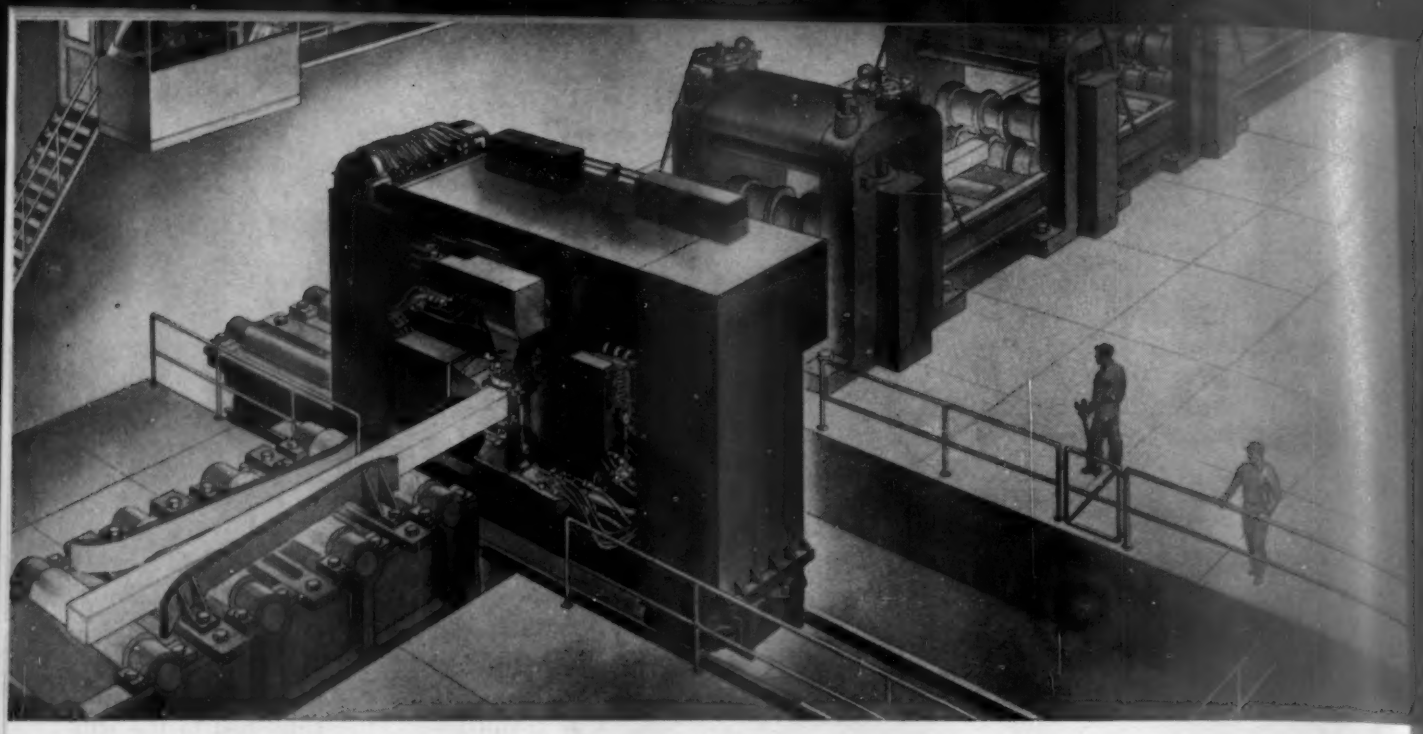


Flame-Planing—Mechanized flame-cutting in several planes simultaneously is a quick and economical way to prepare plate edges for welding. Accuracy of the cuts is comparable to results obtained by using more costly, mechanical methods.



Hand-Operated Cutting Blowpipes (above) are useful for many jobs. When used with gouging nozzles (above, right), a groove can be made quickly in a metal surface.

For more information on Linde methods, please turn the page.



MECHANIZED FLAME-SCARFING ...*helps produce* BETTER STEEL...*faster!*

Mechanized oxy-acetylene flame-scarfing of semi-finished steel is an important engineering development of The Linde Air Products Company . . . important to both the steelmaker and the fabricator because it helps to produce better steel . . . faster!

Through use of Linde-developed oxy-acetylene scarfing machines like that shown here . . . installed right in the steel mill production line . . . faulty surfaces are "skinned" from the hot steel as it rolls through . . . and a higher yield of quality steel is obtained without interruption of production.

For some special steels, such as armor plate slabs, surface removal is accomplished after the steel has cooled . . . partially or completely . . . and been removed from the roll table. This is done by Linde machines that move along the slab. Where mechanized conditioning of steel is not feasible, or for secondary conditioning, oxy-acetylene deseaming is done quickly and economically with Linde's manually operated scarfing equipment.

This BOOKLET *will tell you more about Linde* METALWORKING METHODS

The booklet shown here will be of interest . . . and may suggest new applications . . . to design engineers, to production and maintenance men, to oxy-acetylene process supervisors, and to welding foremen. It describes Linde's oxy-acetylene metalworking methods, and shows the catalogs that you can obtain to aid in your selection of the apparatus and supplies needed for applying these processes. As many copies as you require will be sent without cost by any Linde sales office.

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The words "Linde" and "Unionmelt" are trade-marks.

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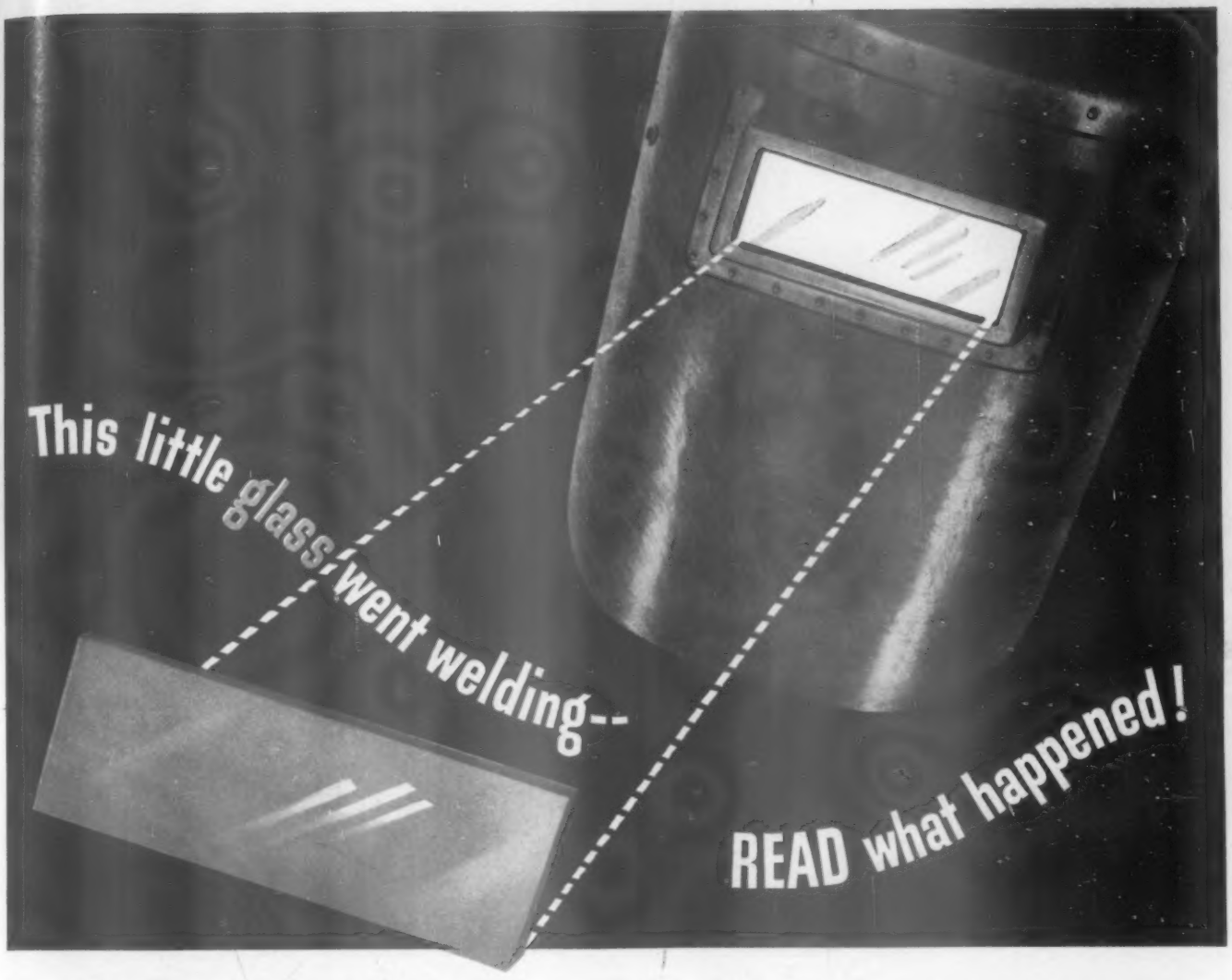

"Dalite" Cover Glasses save West Coast shipyard 19,116 man-hours in one month!

A large shipyard (name on request) enjoyed this saving when they switched from untreated welding-mask cover glasses to Bullock "Dalite" . . . the completely-covered processed glass with the tough . . . no-pit, no-peel . . . baked-on coating that guards against heat breakage and damage from metal splatter.

Saving many minutes—per worker—per day, otherwise wasted in replacing broken or easily pitted glasses, "Dalite" gives real economy. Keeps more welders . . . welding . . . more of the time. If cost is counted as it should be . . . if you pay only for what you use . . . "Dalite" is actually cheaper! Welders tell us that one "Dalite" glass lasts as long as three to five ordinary glasses.

Make this test at our expense. Return the coupon. We'll send you 10 "Dalite" glasses . . . Free! Test them side by side against your regular cover glasses. Put them under a steel cutter's torch. Hold them there . . . right in the slag . . . see the difference!

HOPKINS ENGINEERING CO.

DETROIT 2, MICHIGAN, 2-159 General Motors Bldg., Trinity 19260
CHICAGO 1, ILLINOIS, 230 North Michigan Ave., Central 8509

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L. H. BULLOCK CO., MFR., Berkeley, California

Mail This Coupon, Now!

HOPKINS ENGINEERING CO., 230 N. MICHIGAN AVE., CHICAGO 1, ILLINOIS (WE)

Send free and postpaid, 10 Bullock "Dalite" Glasses. I want first-hand proof that "Dalite" is a great time and money saver.

Name.....*Dept*.....

Company.....

City.....*State*.....

WE
PAUSE A
MOMENT FROM
OUR EFFORTS TO HELP
WIN PEACE ON EARTH—TO
EXTEND SEASON'S GREETINGS.
THIS YEAR HAS SEEN AN EXPAN-
SION IN OUR SERVICE WHICH HAS
BEEN MADE POSSIBLE ONLY BY YOUR
ACCEPTANCE OF OUR WELDING EQUIPMENT

T
H
A
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K
S

. . . and Best Wishes
for the New Year

THE HARRIS CALORIFIC COMPANY
CLEVELAND, OHIO

Photo Courtesy REPUBLIC STEEL CORP.

VICTORY

Merry Christmas and a Victorious New Year

THE CHAMPION RIVET COMPANY

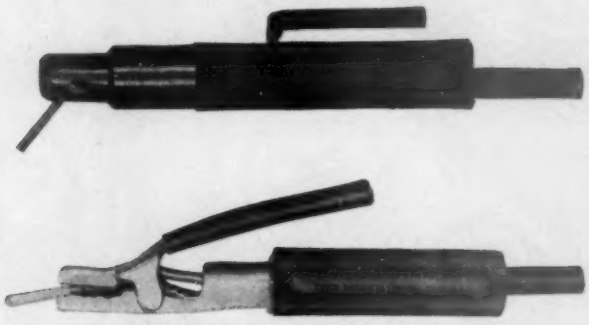
11500 HARVARD AVENUE, CLEVELAND, OHIO . EAST CHICAGO, INDIANA

CONNECTING AMERICA'S WELDING CABLES

PROMPT DELIVERY

TWECO GROUND CLAMPS

Redhead Midget
Redhead Jr.
Redhead Sr.
Perfection No. 500 PM
Ground Hooks and Wedges
Aircraft Tubing Ground



TWECO ELECTRODE HOLDERS

Hol-Grip Jr.	150 AMP
Hol-Grip Sr.	300 AMP
Hol-Grip No. 500	500 AMP
Hol-Grip Super	600 AMP
Standard	300-400 AMP

Type "H" Hol-Grip and Standard

THE EFFICIENCY OF YOUR CABLE CONNECTIONS

DETERMINES THE QUALITY OF YOUR WELDING

No. 2-H and 2-S Twecolugs
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TWECO MECHANICAL CABLE LUGS

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SHOWS ASSEMBLY
INSERT CABLE STRANDS
TURN SCREW INTO
NUT HELD STATIONARY

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No. 1 and 2 Sol-Con Connector
45° Sol-Con Machine Terminal
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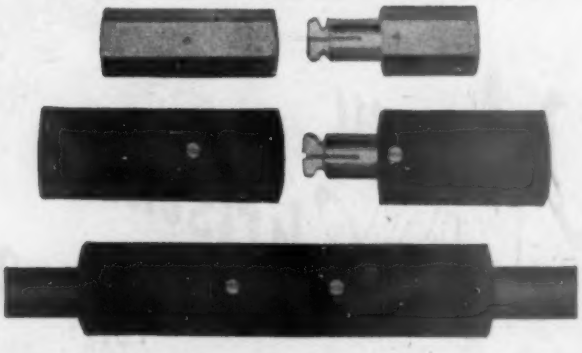
TWECO CABLE CONNECTORS



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English at Ida — MANUFACTURERS — Wichita 7, Kansas, U.S.A.

Distributed in Canada by G. D. PETERS & CO. OF CANADA, Ltd. 1021 New Birks Bldg., Montreal

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ONE of the best kept secrets in the welding industry is the feasibility and the amazing economy of Unamatic hard re-surfacing of rolls of all kinds, shafting, wheels, bearings and other cylindrical elements that wear down in service. Railroads and the steel industry can save tens of millions of dollars every year by simple applications of Unamatic re-surfacing to wheels, axles, rolls, etc. now discarded instead of being easily reclaimed.

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Re-surfacing of cylindrical pieces large or small is a field for which circumferential welding by the Unamatic process is especially adapted. Hardness of 200 to 450 Brinell on mild steel, and higher with high carbon, is readily attainable.

Right now wider use of Unamatic re-surfacing can save man power, release materials, save time and increase war production. After the war it will still be as economically sound and profitable.

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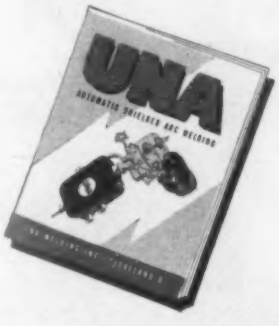
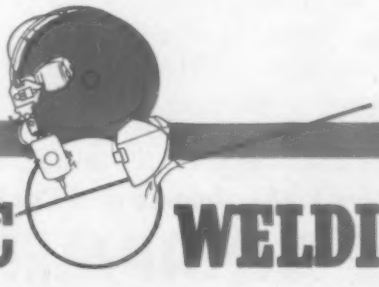
For more facts about the wide range of successful and highly profitable Unamatic Welding, write today for the new illustrated UNA catalog.





CONTROLLED QUALITY **UNAMATIC WELDING** CONTINUOUS PRODUCTION

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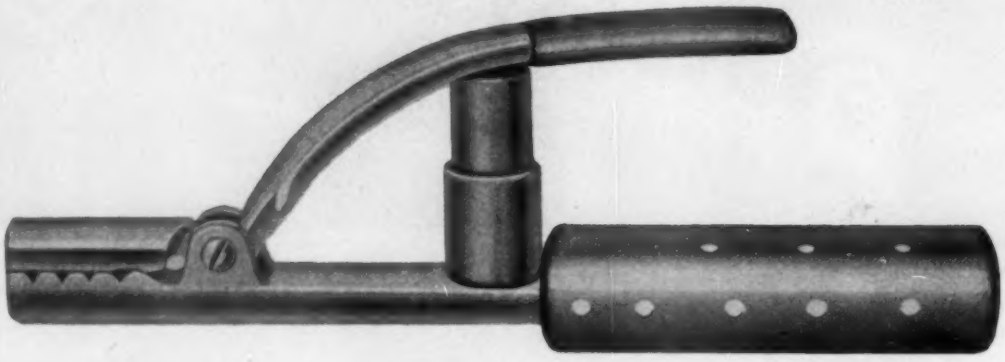
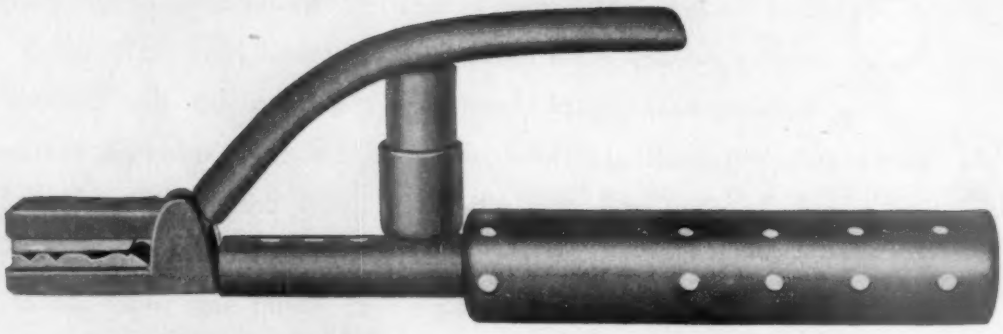
THERM-ARC ELECTRODE HOLDERS

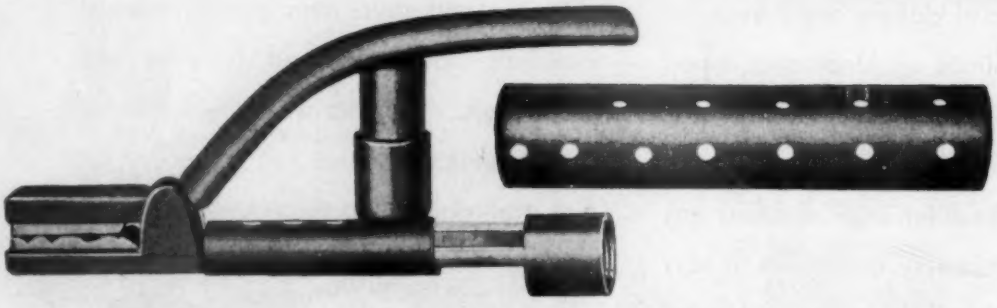
A Type of Holder that has Proven Itself
The only fully-insulated coil spring holder



TYPE N
Partially Insulated



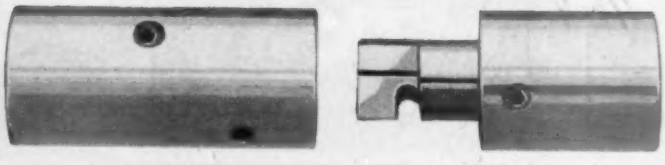
TYPE K
Completely Insulated



TYPE M
Detachable Completely Insulated With Removable Front

THERM-ARC CABLE CONNECTOR

This unit can be connected or disconnected quickly by a very short turn. The action is instantaneous and a tight, contacting connection is assured throughout entire circumference of male plug; no possibility of loosening while in use.



Write for our attractive, illustrated, descriptive booklet of THERMEX Holders and Cable Connectors.

THERMEX EQUIPMENT COMPANY

2045 Celia St. **Tel. TYler 7-1337**

DETROIT 8, MICH.

MORE MAN HOURS THROUGH *Extra* Safety

☆ ***All Meco Safe-T-Chek Regulators*** are equipped with the special patented Safe-T-Chek bleeder valve.

This valve, located in the high-pressure inlet, holds back the flow of oxygen until both seat and diaphragm can come into operating positions *and* controls the flow of oxygen in case of emergency—worn, or burning-out seats —or diaphragm failure.

This extra safety factor, found only in Meco Safe-T-Chek Regulators, thus protects against production delay—protects against regulator failure—and protects against the factors of human accident when regulators cease to function properly.

Enjoy all these Extra safety factors by specifying Meco Safe-T-Chek Regulators.

Meco

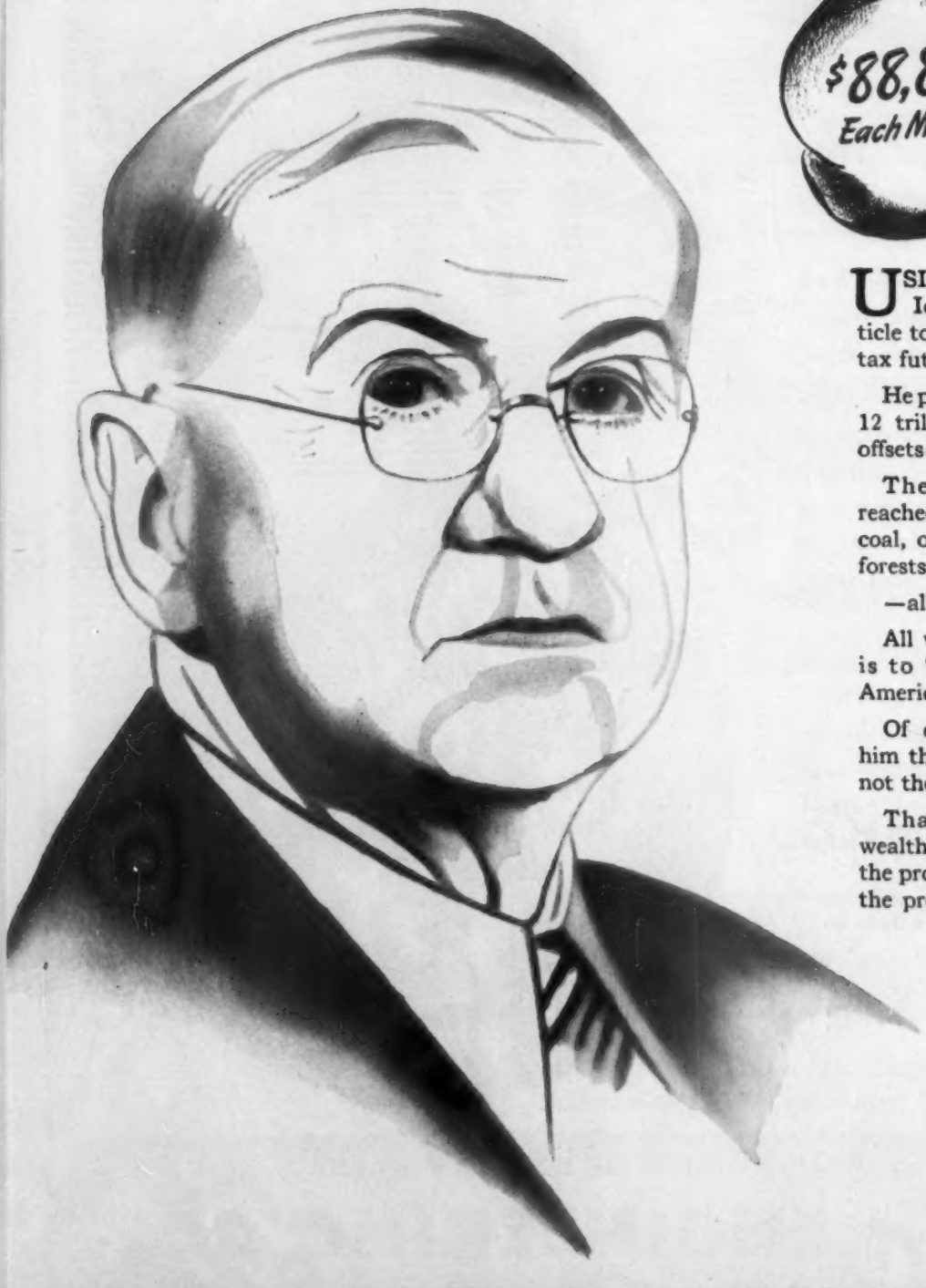
WELDING AND CUTTING EQUIPMENT

MODERN ENGINEERING CO.

3413 PINE BOULEVARD ST. LOUIS, MISSOURI

—then he said to himself

"We are every one a Croesus"



USING those words, Multi-Job Ickes writes a magazine article to allay all fears of a terrible tax future.

He proves that America is worth 12 trillion dollars—which neatly offsets our 150 billion debt (to date).

The astronomical figure is reached by computing all the iron, coal, oil, etc., in the ground and forests.

—all our *natural resources*.

All we have to do to pocket it is to "Maintain the freedom Americans have enjoyed."

Of course, his inner self tells him that wealth in the ground is not the pocketable kind . . .

That it cannot become real wealth until it is worked—until the profit motive is applied—until the profit is secured.

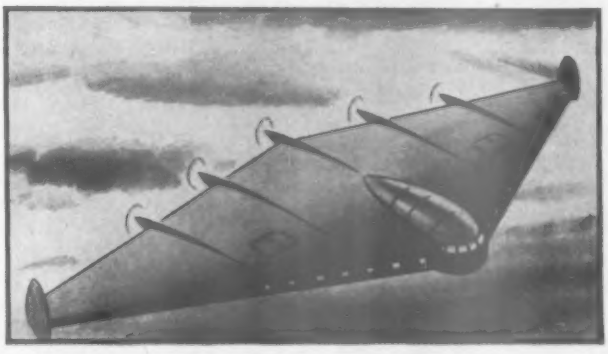
Here, Mr. Ickes, is Real Wealth

Bridges (Case History)

The public hears only about the spectacular big bridges. But in 1940 and '41 about $30,000,000 was spent on 40′ to 80′ bridges. A bridge engineer has written an article, "Steel and Concrete Bridges Compared" showing how nearly $3,000,000 can be saved annually on such bridges by *recourse* to Arc Welding.

Earthmoving Machines (Case History)

Recourse to Arc Welding made possible the design of a wheel-type tractor unit at a yearly production saving of $348,000 over conventional construction. Use of 600 units of this type of equipment on hauls of 5000 feet saves $10,764,000 annually over conventional earth-moving equipment and methods.



Aircraft (Case History)

Research now has developed a successful method of arc welding magnesium alloys, *recourse* to which shoots into terrific potentials. On the all-wing plane (on the way) the difference in drag between the conventional riveted airfoil and the low-drag arc welded magnesium wing is estimated at 50% . . . saving 20 cents per ton-mile—or $1,875,000 over the life of the plane—or $750,000,000 on a 400-ship fleet.

Watercraft (Case History)

Arc Welding in ship construction saves time and steel (about 10%-20%). But that's only the beginning. *Recourse* to Arc Welding also cuts costs in other ways. By eliminating bumpy rivet heads, it makes it easier to insulate the ship . . . to cover the deck . . . to run the piping . . . dozens of refinements. Such items aggregate yearly savings of about $600,000,000 according to one authority.

Someone could well write a magazine article proving a potential of WELD WEALTH equal to the national debt.

But there again the money is not pocketable until ARC WELDING is used . . . until the article is read and acted upon.

Even now the press is full of articles showing the money value of arc welding. Not all the people who should read them *do* read them. Which makes one feel that there is little difference between a man who cannot read and one who does not.

THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO

America's greatest natural **recourse**

ARC WELDING

P&H ARC WELDERS

Why IS THIS THE OUTSTANDING WELDER VALUE?

Welder-wise buyers choose these WSR machines on the basis of sheer values!

Lower Cost Per Ampere

With clear-cut WSR (Welding Service Range) ratings, you know the machine's exact limits of *usable* welding current—from minimum to maximum. You know the price you pay for welding heat—the cost per ampere, based on the machine's maximum capacity. You buy more wisely—save money on your initial investment as well as on operating costs.

Single Heat Control

Only one adjustment to obtain any desired welding current. Arc response is automatic on all classes of work—downhand, vertical, or overhead—with all types of electrodes. There's no confusion about current settings; there's less chance for error. Training time is also reduced.

"Visi-Matic" Calibration Plate

The operator can instantly select the exact current required for each of the three basic classes of electrodes. This exclusive P&H advantage assures the operator of the correct heat across the arc for low, medium or high voltage requirements.

Write for Literature

Get full information about these modern, simplified machines; built in WSR capacities from 60 to 500 and from 80 to 600-ampere capacities. See your P&H representative, or write us for literature.

P&H welding service is complete, including A.C. and D.C. Arc Welders, Welding Electrodes, Welding Positioners, Production Welding Control Systems, Electric Hoists, Cranes, etc. Write for literature.

General Offices: 4513 W. National Avenue, Milwaukee 14, Wis.

HARNISCHFEGER CORPORATION

ARC WELDERS • EXCAVATORS • ELECTRIC CRANES P&H MOTORS • HOISTS • WELDING ELECTRODES

"THIS YEAR, LET'S PAY THE BONUS IN WAR BONDS

. . . and drive even harder on the pay-roll savings plan!"

Make War Bonds the Christmas Order of the Day. Urge your workers to make their personal Christmas gifts in the form of War Bonds—and practice what you preach! Make this a 100% War Bond Christmas—to insure future Yuletides of peace and prosperity.

Make up your own posters to spread the "War Bonds for Christmas" story across your plant. Tell the story again and again on bulletin boards, in your plant magazine, and on pay envelope stuffers.

But don't forget your basic, all-important Pay-Roll Savings Plan. How's it going, these days? Perhaps it needs a bit of stoking-up right this very minute, to hold its full head of steam against the competitive demands of the holiday season.

Well, you're the man to stoke it! You can't expect it to keep running indefinitely on last summer's enthusiasm. See to it that your participation percentages, and your deduction percentages, *both* end up the year at new levels.

Every month, now your Pay-Roll Savings ought to run well ahead of the preceding month. *For so many families that formerly depended on the earnings of a single worker, now enjoy the combined earnings of several.* Such *family* incomes are doubled, trebled, even multiplied many times.

Now's the time to turn as much as possible of these increased earnings into War Bonds—War Bonds for Christmas . . . and War Bonds the whole year 'round!

GIVE THE PRESENT WITH A FUTURE—WAR BONDS!

This space contributed to Victory by **THE WELDING ENGINEER**

This advertisement prepared under the auspices of the United States Treasury Department and the War Advertising Council

THERE IS NOTHING BETTER ON THE MARKET!

"MAJOR" RUBBER COVERED SUPER-FLEXIBLE WELDING CABLE

SPECIFICATIONS

Size	Amps.	Strands	O.D.	I.D.	Wt. in lbs. per M ft.
6	75	950	.400	.210	132
4	125	1029	.495	.275	202
3	150	1323	.500	.305	235
2	200	1666	.560	.335	295
1	250	2156	.625	.400	373
1/0	300	2646	.675	.440	450
2/0	375	3381	.750	.490	570
3/0	450	4284	.815	.545	705
4/0	550	5376	.900	.635	860

Copper conductor consists of fine bare wires, properly stranded to give extreme flexibility.

A separator is applied over the conductor to strip rubber in order to leave bare copper for attaching to lugs and electrode Holders.

Outer jacket is WPB approved synthetic type that has high tensile strength, maximum abrasion resistance. It is tough, durable, waterproof and extremely flexible.

Prompt Shipments - - Usually From Stock!

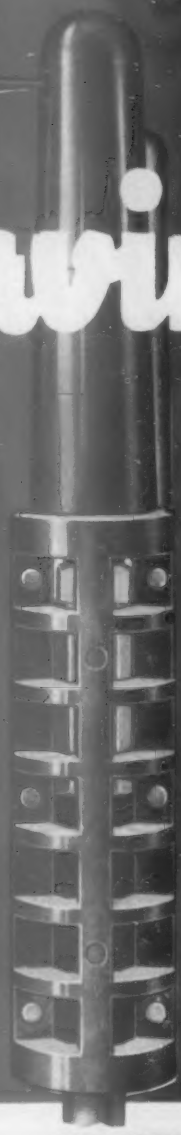
WELDING ENGINEERING COMPANY

MILWAUKEE, WISCONSIN

MANUFACTURERS—DISTRIBUTORS

OFFICES AND AGENTS ALL OVER THE UNITED STATES

HERE'S YOUR Saving ON EVERY ROD



RUNS 7 TO 14%

WELLS "Suregrip" ROD SAVER
(ELECTRODE HOLDER)

ow much would a 7 to 14% yearly saving your rod costs amount to in cash?

Whatever the amount it is available to ou once you start using a Wells "Suregrip" od Saver. In many other ways the Rod aver is exceptional. It is not uncommon or these streamlined holders to be in con-inuous service for from 3 to 4 months, ithout replacement or repair other than nsulator caps.

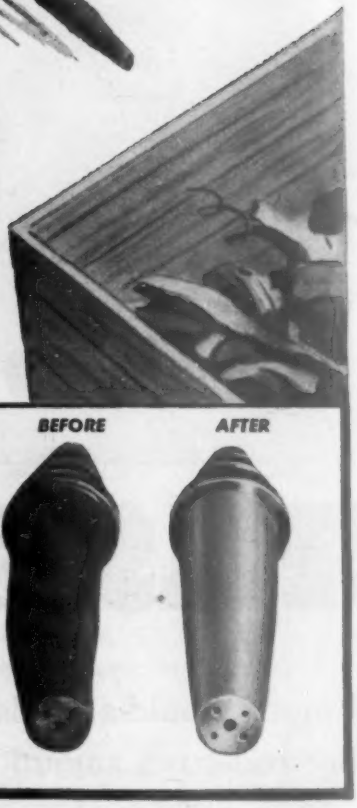
Other exclusive features are: its tremendous grip which lasts as long as the holder itself, the quick rod change that takes only a twist-of-the-wrist, the air-conditioned handle that reduces surface contact with glove by 50%. This amazing holder is ideal for use in cramped quarters; its overall length is only 10½". Extremely light weight for amperage it carries. All metal parts get full protection from tough, durable insulators. Lay the "Suregrip" anywhere without danger of arcing. Write for detailed literature.

Martin Wells *Manufacturer*

86 COMPTON AVE. LOS ANGELES 1, CALIF.

DON'T SCRAP that AIRCO Tip!

Let an Airco Repair Station recondition it for you



Here's a typical result of Airco Repair. The tip at left—battered, nicked, and choked with carbon—was made good as new by skillful repairs.

Copper is one of the most critical materials. It must be conserved.

Here is one way to do it—don't discard a worn Airco welding or cutting tip until you've made certain it cannot be reclaimed. Send all your damaged Airco tips to us. Our skilled repair men will inspect them thoroughly and put them back into first-class working order . . . unless they're beyond repair.

In this way Airco can help you reclaim many tips that would otherwise end up in the scrap-box. So see that all old Airco tips are collected now and forward them to the nearest Air Reduction office.

★ BUY UNITED STATES WAR BONDS ★

AIRCO WILSON

AIR REDUCTION

General Offices: 60 EAST 42nd STREET, NEW YORK 17, N. Y.

In Texas: MAGNOLIA AIRCO GAS PRODUCTS CO. • General Offices: HOUSTON, TEXAS

Classified Section

HELP WANTED

Executive

WOMAN ENGINEER

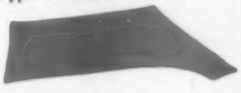
Progressive war-civilian organization, New York City, offers permanent position, excellent opportunity, now and post-war, woman engineer having practical experience metals, machinery, welding, writing technical copy; stenography helpful. Please submit resumé background, experience, age, salary, references, when available. Essential workers need release papers. Box No. December No. 3.

METALLURGICAL ENGINEER

Highly progressive concern located New York City, welding industry, desires secure services qualified metallurgical engineer with mechanical and welding experience. Position offers excellent opportunity now and postwar. Ability and experience in sales promotion and research and development required. Willingness to travel part time necessary—presenting lectures, etc. Please submit resumé of background and experience, stating age, draft status, salary requirements, references, when available; submit small photograph. Box No. December No. 2.

HELP SAVE STEEL
BY APPLYING WIESE UNITS TO AGRICULTURAL TOOLS
Prepare your shop for this type of work

U. S. Patents 2,013,818, 2,051,234 and 2,226,084.



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WIESE PLOW WELDING COMPANY, PERRY, IOWA
Originally New Process Plow Welding Co.

MISCELLANEOUS

Best Paid Welding Jobs go to men who are best trained. Get thorough training at this non-profit arc welding school. Expert instructors, individual attention and latest type practice machines. Write today for full details and low cost. Hobart Welding School. Box U-1232, Troy, Ohio.

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Distributors wanted by manufacturer to handle welding electrodes, oxy-acetylene rods and accessories. Aircraft and shipyard accounts particularly desired. Box No. December No. 1.

FOR SALE

Arc Welders For Sale; Low prices, no priority, all sizes, makes, types; Lincoln Vertical 100 Amp. $125; 150 Amp. $135; 200 Amp. $145; 300 Amp. Lincoln engine sets. Also Lincoln 500 Amp. SAC units. Big stock reduction. Welding Engineering Co., 264 E. Ogden Ave., Milwaukee 2, Wis.

ALADDIN ROD

No Puddling
No Flux

Weld White Metal (die cast) Braze Aluminum easily and quickly when you use ALADDIN ROD and Patented Method. The only rod guaranteed to produce welds of greater tensile strength than the original metal. Instructions with every pound. Write us for Free Literature. Rod sizes: 1/16", ⅛", 3/16", ¼", and complete assortment.

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Dept. A, P. O. Box 935, Madison Square Station, Grand Rapids, Mich.

Special WELDING POSITIONERS

We Solicit Special Positioning Problems
Submit your out-of-the-ordinary positioning problems to us for solution. BENTLEY designers and engineers can provide the correct answer.

BENTLEY WELDERY, Inc. **Syracuse, N. Y.**
DESIGNERS and MANUFACTURERS of WELDING POSITIONERS and SPECIAL EQUIPMENT

Secure COMPLETE PROTECTION with the Best in Welders' Clothing

"SAF-T" Garments for Men and Women Welders

The Accepted Line of Protective Leather Clothing

Samples and Prices Sent on Request
Ask Your Distributor or Write

5 SK Overalls for Men

Coats
Aprons
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Overalls
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Sleeves
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New catalog now in preparation

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FRED JESSAR

BRASS MAKES BULLETS

REGO Gas Plant Equipment to be safe, must be made of brass and other vital metals.

Conserve your equipment. You may not get more.

REGO ARMY E NAVY

LISTED UNDER REEXAMINATION SERVICE UL OF UNDERWRITERS' LABORATORIES, INC.

The BASTIAN-BLESSING Co.

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Pioneers and Manufacturers of Precision Equipment for Using and Controlling High Pressure Gases

ADVERTISERS IN THIS ISSUE

A

Acme Mfg. Co. 85
Adjustable Clamp Co. 104
Air Reduction Sales Company .. 40
Aladdin Rod & Flux Mfg. Co. .. 105
Allis-Chalmers Co. 18
American Brass Co. 19
American Chain & Cable Co., Page Steel & Wire Div. 67
American Optical Co. 11
Ampco Metal, Inc. 91
Anti-Borax Compound Co. 103
Arcos Corporation ..... Inside Back Cover
Atlas Welding Accessories Co. . 17

B

Badger Mfg. & Sales Co. 104
Bastian Blessing Co. 106
Belden Manufacturing Co. 83
Bentley Weldery, Inc. 105
Bonney Forge & Tool Works .. .. Back Cover
Bridgeport Brass Company 92

C

Central Steel & Wire Co. 69
Champion Rivet Co. 29
Chicago Eye Shield Co. 100
Chicago Hdw. Foundry Co. 97
Chicago Mfg. & Distributing Co. 82
Cincinnati Tool Co. 104
Coast Metals, Inc. 80
Colonial Tanning Co. 104
Cullen-Friestedt Co. 86

D

Dallet Co., The 89
Davis Engineering Equipt. Co. . 95

E

Eccles & Davies Machinery Co., Inc. 98
Eisler Engineering Co. 93
Electroloy Co., The 101
Eutectic Welding Alloys 101

F

Faulk, F. R. 103

G

General Blower Co. 108
Girdler Corp. 59
Glenn-Roberts Co. 73
Great Lakes Steel Co. 14-15
Greyhound Electric Mfg. Co., Inc. 103

H

Handy & Harman 12
Harnischfeger Corp. 8, 36, 93
Harris Calorific Co. 28
Haynes Stellite Co. 21
Hercules Electric & Mfg. Co., Inc. 13
Hobart Bros. Co. 3, 103
Hopkins Engineering Co. 27

I

Independent Engineering Co. 16, 103
Industrial Gloves Co. 100
Inter-State Sales Co. 100

J

Jackson Products ..... Front Cover
Jessar, Fred 105
Jones Engineering Co. 78

K

Knu-Vise, Inc. 96
Krembs and Company 102

L

Larkin Lectro Products Co. 101
Lee-Wood, Inc. 95
Lichtman & Sons, Inc., J. 77
Liquid Carbonic Corp. 85
Lincoln Electric Co. 34-35
Linde Air Products Co. 23, 24, 25, 26
Lyon-Raymond Corp. 95

M

McKay Company 10
Macklin Company 7
Mallory & Co., Inc., P. R. 9
Marquette Mfg. Co., Inc. 88
Metal & Thermit Corp. 4
Metal Bond Mfg. Co. 103
Metro Mfg. Co. 99
Mid-States Equipment Co. 97
Modern Engineering Co. 33
Moslo Machinery Co. 87

N

National Carbide Corp. 93
National Cylinder Gas Co. 61
National Steel Corp., Div. of . 14-15
Norton Co. 22

P

Page Steel & Wire Division ... 67
Pierce Governor Co. 90

R

Rall Supply Co. 103
Ransome Machinery Co. 73
Ray Proof Corp. 99
Reid-Avery Co. 76
Resisto-Loy Co., The 71

S

Safety Gas Lighter Co. 99
Safety Shock Mfg. Co. 72
Sciaky Bros. 63
Sellstrom Mfg. Co. 104
Shawinigan Products Corp. 103
Shoot-a-Lite Corp. 99
Sight Feed Generator Co. 87
Skilsaw, Inc. 94
Smith, A. O., Corporation 6
Special Welding Alloy Co., Inc. 103
Standard Steel & Wire Co. 101
Stanley Electric Tool Div. 91
St. Pierre Chain Corp. 95
Stultz-Sickles Co. 100

T

Taylor-Wharton Iron & Steel Co. 79
Thermex Equipment Co. 32
Titan Metal Mfg. Co. 89
Tweco Products Co. 30

U

Una Welding, Inc. 31
Union Carbide & Carbon Corp. 21, 23, 24, 25, 26
U. S. Steel Supply Co. 93
Universal Power Corp. 102

V

Victor Equipment Co. 42

W

Wall-Colmonoy Corp. 97
Welding Alloys Mfg. Co. 99
Welding Engineering Co. 38
Wells, Martin 39
Westinghouse Electric & Mfg. Co. .... 65 and Inside Front Cover
Wiese Plow Welding Co. 105
Wilson Products, Inc. 74
Wilson Welder & Metals Co. .. 81
William Wrigley Jr. Co. 84

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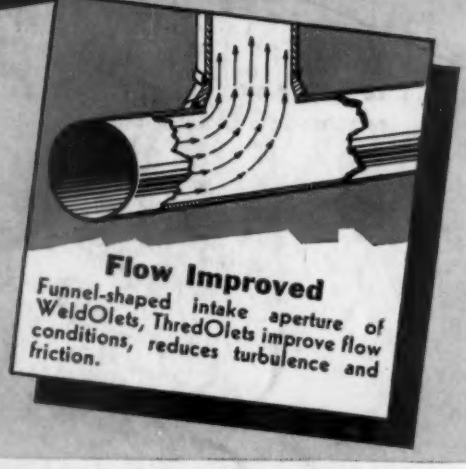

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